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CENTRAL AND LOCAL GENERAL INFORMATION SERVICES

As the Royal Society Conference on Scientific Information closes, it is not inappropriate to consider the wider questions of the diffusion of information in general. The debate in the House of Commons on May 13 on the Civil Estimates for the Central Office of Information covered a wide field; from one point of view it was of interest on account of the statement which it drew from the Lord President of the Council, regarding information services and publicity organisation of the Government. That statement should do something to dispel the confusion which, as the debate itself indicated, still persists between a fact-finding organisation and that concerned with the dissemination of the information collected. Of the first the Economic Information Unit is typical, being concerned to supply the Government with information on the broad facts of the economic state of the nation and the economic problems of the world in relation to Great Britain.

While the Central Office of Information also deals with economic policy and exposition, working with the chief planning officers of the Central Statistical Office, with the Economic Section of the Cabinet Office and with the economic Departments of State, the research aspect of its work is less pronounced than in the Economic Information Unit, and the emphasis is rather on exposition. There can be no serious question about the need for the research aspect of information or intelligence work: the questions are rather whether there is enough of such fact-finding as a basis for policy, whether the departments are as active in this field as they should be, how best to correlate the work of the individual information units which clearly the departments must possess, and whether the work is of the highest quality and its results made known throughout the whole organisation of government with the swift efficiency that is desirable. It is on the aspect of dissemination that criticism has centred. Is that dissemination sufficiently effective to avoid unnecessary duplication? Does it reach the official who needs it sufficiently promptly? And does it reach the general public in a way that ensures their co-operation and understanding of the issues involved?

On the internal aspects of dissemination little was said in the debate. Criticism centred rather on the weakness of the relatively small amount of Central Office of Information publicity directed towards the general body of the public. Some of the criticism is obviously to be discounted. Every step taken by a party in power to direct and control the sources of public information is naturally watched with healthy suspicion. However anxious a Government may be to avoid using departmental channels of publicity for propaganda, it is never easy to avoid the danger; further, public relations officers can, in the nature of things, easily become a cloud of witnesses for the defence of Ministers.

There can be little doubt that the Central Office of Information justifies its existence, and that the

departmental information services and public relations officers are doing valuable work. The importance of such services was well indicated in a recent broadsheet issued by Political and Economic Planning. None the less, they call for friendly but searching scrutiny; while there may be much to praise, there is still room for improvement in the standard as well as the cost of the work, and Mr. Herbert Morrison seemed not indisposed to admit the importance of quality.

It can be taken as common ground, as Sir D. Maxwell Fyfe indicated, that each Minister should be responsible for the information policy of his own department with the aid of a small but highly trained information staff; that there should be adequate means for the co-ordination of both home and overseas information services so as to ensure consistency of policy and presentation; and that a central Government agency should carry out on behalf of departments most of the technical and production functions. What is at issue is rather the use made of these organisations, and the quality of the work. In particular, there is the question how far the work of informing the public, for example, in foreign affairs, should be left to Government publicity organs rather than to the Press. That question may well be the fundamental factor behind much of the criticism directed against the shortcomings of Government publicity organisations, and the criticism would be less sharp were it not for the way the Government's economic policy is cramping the free discussion and reporting of public affairs in the Press.

To complete the picture which the Lord President of the Council gave on May 13, it is necessary to turn to the statement Sir Stafford Cripps made on June 1 giving the membership of the Panel on Technical Information Services and its terms of reference. Under the chairmanship of Dr. A. King, of the Lord President's Office, the Panel is to review existing information services for distributing scientific and technical information, to consider what improvements can be made to ensure a rapid and wide dissemination of such information to industry and to make recommendation to the Committee on Industrial Productivity accordingly. That is only one aspect, and a highly specialized one, of the question, and indeed goes beyond the field of Government publicity in the strict sense; but it will be surprising if the Panel does not comment on the way in which the Government's newsprint policy retards the free dissemination of scientific and technical information through the scientific and technical Press.

It is true that certain concessions have been made and the position is easier than it has been. No scientific man, however, can be satisfied with the present position of the scientific and technical Press in Britain, whether in respect of periodicals or of books. The suspension of periodicals in the fuel crisis of 1947 is only one of a number of Government actions which engender distrust of its good faith in regard to freedom of communication; nor can scientific and technical publications be sharply distinguished from the general body of the Press. It is precisely because the Government has such a poor record in this matter that so much bitterness has been manifest in recent debates on the supply of newsprint and of books.

The Government, in fact, has still to show that it is sincere in the support which it gave at Geneva to freedom of information. The effect of the present situation is well displayed in an article in *The Fortnightly Review* of June by W. C. Andrews. This article deserves to be studied by everyone concerned with the preservation of freedom of communication. Mr. Andrews shows why newsprint cannot be treated as just another material commodity, and some at least of the current criticism of Government information services is inspired by resentment of the apparently lavish supply of paper at their disposal in the face of the drastic curtailment of the space available for public discussion and comment in the independent Press as compared with a decade ago. It cannot be too strongly emphasized that this restriction, even if it is due to economic motives alone, is an effective form of censorship. Important events are reported imperfectly or not at all, and the formation of sound opinion is severely handicapped. Nor is that all. Mr. Andrews indicates how adverse are the repercussions on the functioning of democratic institutions, for example, local government; and the interim report of the Consultative Committee on Publicity for Local Government presented last autumn might well be studied afresh from this point of view. The Committee was agreed that much more needs to be done to stimulate publicity at both national and local levels, and it emphasizes, like Mr. Andrews, that the problem is mainly one of widespread lack of knowledge leading to apathy. The report is, in fact, like his article, a commentary on the aphorism of Junius which Mr. Andrews quotes: "The liberty of the press is the palladium of all the civil, political and religious rights". Local authorities have an undoubted duty to make information public by the most suitable means, and some of them have been justly criticized for failure to do so.

The report suggests that every local authority should review all its channels of communication with the public of its area and consider how these can be improved and extended. It does not advocate the expenditure of large sums on centralized publicity. Rather the Committee believes that local authorities can carry out consistent and effective publicity without elaborate machinery and heavy expenditure. It does hold, however, that much more could be done to educate officials of all grades in the right way of dealing with members of the public, and that the public relations spirit should permeate the whole organisation, members as well as staff. It insists also that one of the main needs is the fullest possible use of the facilities offered by the local Press for supplying regular information to the local people. No policy for improving publicity for local government can, in its opinion, be effective unless every effort is made to secure the co-operation of local newspapers.

This section of the report is of particular interest, for it is here, as Mr. Andrews indicates, that Govern-

ment policy has proved most hampering and is indeed tending to frustrate the functioning of democracy. Opportunity for public comment and debate is essential to secure action in accordance with the facts of a situation and not on lines dictated by prejudice or vested interest. It is just as true at the local as at the national level that scientific and technical factors must be explained to the public. A closely related matter is the control of nationalized industries. The recent resignation of Sir Charles Reid from the National Coal Board has given warning of the danger that due weight may not be given to the technical factors in the reorganisation of this nationalized industry; unless some means of public discussion are found, there is real danger that a fresh set of sectional interests and prejudices will arise to obstruct the technical reorganisation that the public interest demands.

If the scientific man or technical expert, such as the mining engineer, is to be given the executive authority he needs to carry out the technical functions entrusted to him, the co-operation and support of the public as well as of the other workers in the industry concerned will often be required. For this reason alone the question of the control of nationalized industry and the responsibility of such industries to Parliament is a matter of close concern to him. It is evident that Parliament itself is much exercised over the special status of the boards of nationalized industries, and that while there is no desire to interfere with matters of day-to-day administration, there is a desire for fuller information on policy and for opportunity for public criticism. The Speaker indicated in the House of Commons on June 7 that he was prepared, if it was generally approved, to exercise his discretion to direct the acceptance of questions asking for statements to be made on matters about which information had been previously refused, provided that, in his opinion, the matters were of sufficient public importance. Public importance is one of the tests for motions for the adjournment of the House and was not in his experience an unduly difficult test to apply. This suggestion the Government is prepared to accept; it is probably to be welcomed as affording further time for the whole question of public information and public relations to be re-examined.

What must be remembered, however, is that any such procedure inside the House of Commons will still be insufficient while the newsprint position restricts the Press from reporting such questions and debates at reasonable length. We come back to the point with which we started, that freedom of information and communication are an essential element in the functioning of democracy as well as in the application of knowledge to public affairs and the advancement of science; it is impossible in the presence of a direct censorship or of that indirect censorship which the absence of adequate supplies of paper or print imposes. There are few members of the Government who, despite obvious touchiness in regard to criticism, can fairly be suspected of an illiberal attitude on this question of information and independent comment. None the less, in spite of the work of the British delegates at Geneva on the resolution that freedom of information is a fundamental right of the people and the touchstone of all the freedoms to which the United Nations are dedicated, the Government's attitude on the question of imports of newsprint still gives rise to serious concern. Such resolutions are hypocritical unless they are accompanied by practical evidence of concern to provide the essential means for a free Press, technical and scientific, as well as general, to discharge properly and efficiently its function of keeping men and women informed on advances in knowledge and on the issues involved in every aspect of public affairs. Nor can any Government information service, however efficient and free from party bias, undertake that task without the support of an independent Press which has also the resources for acting as an efficient instrument of information.

THE SEARCH FOR THE GERMAN ATOM BOMB

Alsos

The Failure in German Science. By Prof. Samuel A. Goudsmit. Pp. xiv+260. (London: Sigma Books, Ltd., 1947.) 15*s*. net.

PROF. GOUDSMIT has written a racy account of the part played by the Alsos mission in the investigation by Allied intelligence of the German uranium projects, which makes very good reading. He tells some first-class stories; the one about the radioactive wine dispatched by air to Washington deserves to become a classic; and he has some interesting things to say about the methods used by his unit and about security in armament research. His book necessarily treats only part of the subject, namely, the work of scientists who accompanied the advancing armies from the time of the liberation of Paris until the end of the War. It is to be hoped that it will some time be possible to release an account of earlier investigations, of the extent to which it was possible for military intelligence to keep track of the relevant activities of German scientists, and of the conclusions that were drawn. It was not until the occupation of Strasbourg that the Alsos mission obtained certain proof that the Germans were far from obtaining either an atomic bomb or radioactive poisons; but whether at this or at an earlier stage of the War fear of these developments was a potent motive in Allied strategy, or whether enough evidence existed to show that they were most unlikely, Goudsmit's account does not say.

But to the reviewer by far the most interesting part of the book is the description of Goudsmit's meetings with the German scientists, and his discussion of their motives in working or not working for the German war machine. This is a subject of profound interest and importance, for the question of the relation of the scientific worker to the State is one which every one of us has to face, even though we hope that the problem will not soon be again so acute as it was in the Third Reich. It is of particular importance also in connexion with the re-establishment of normal relations with the scientific workers of Germany. For a German professor invited abroad acquires thereby some prestige in his own country,

and it is widely felt in Britain that this prestige should not be conferred where it is not deserved.

But a discussion of the motives of German scientists concerns the actions of living men, who can and do state their side of the case, as has Von Laue recently* and Heisenberg in an article in *Nature*† on the German work on uranium. The subject is one likely to arouse the bitterest emotions, both in Germany and among those in Britain who have suffered personal loss in the War or at the hands of the Gestapo. It is therefore particularly necessary that Allied scientists, if they approach it at all, should do so with all possible objectivity, quoting, if possible, from documents rather than hearsay, and judging a man only on the basis of generally available evidence. In this respect it is possible to offer one criticism of Goudsmit's book. It contains a witty description of the scene among the German scientists interned in England when they heard the news of Hiroshima. First they did not believe it possible; then they saw how it was done, and were ashamed that they had not thought of the method themselves; and finally, he says, they built a rationalization for their failure, by denying that they had ever tried to make an atomic explosive.

How does Goudsmit know all this? Unless it was by questioning the scientists afterwards, it must be assumed that some record of the conversation was obtained. In that case, Goudsmit's conclusions would have been more convincing if the record could have been published, rather than this dramatization of it. Perhaps this is at present impossible; but in the circumstances this record of the motives of the German scientists reads rather like a theory in physics based on unpublished experimental facts, so that it is impossible to judge how valid or fair the conclusions are.

The truth in a matter like this is unlikely to be simple. It is clear that German scientists were by no means so unanimous in their desire to work for the war effort as were the British and Americans. Some, of course, did so; others—a point which Goudsmit makes very well—wished to do so and were prevented by the stupidities of the Nazi organisation; others held aloof as much as possible. There also seems to have been, especially towards the end of the War, a rather cynical desire to obtain from the war machine facilities for scientific projects of fictitious military value, to "use the war to help science". To the men working on the uranium project, as the War drew to an end, it must have been clear, whether or not they realized the potentialities of plutonium or of a fast chain reaction with uranium 235, that no weapon for Germany could come out of their work. At that time it must have been true that the aim of their work was to obtain machines, or prestige, but not bombs. The innocence of the motives with which it was started is, however, less certain; no one who realized that a bomb might result from his researches can say honestly that he did nothing which might have armed the Nazis with atomic weapons.

It is doubtful, however, whether this question of motives in research is of lasting importance for the reputation of German physics. Many of us in Britain can realize only too well the strains to which a German scientist of integrity has been subjected; the conflict between the desire to stay and save from the Nazis something of German culture and the desire to escape to a free country; the reluctance to be an "armourer of Himmler and of Auschwitz", and the desire to strike back at the destroyers of Hamburg and of Dresden. In a few years time, when passions have cooled a little, the welcome that a German scientist will find among his colleagues in the West should depend very little on the extent to which, under the stress of war, he worked on weapons. It is to be hoped that it will depend far more on his earlier record, on the opposition that he offered within and outside his university, at the time when opposition was still possible, to the steps that stifled freedom in Germany and made war inevitable.

N. F. Mott

* *Bulletin of the Atomic Scientists* (April 1948).
† *Nature*, **160**, 211 (1947).

THE FAEROES

The Atlantic Islands

A Study of the Faeroe Life and Scene. By Kenneth Williamson. Pp. 360+23 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1948.) 16*s*. net.

MR. WILLIAMSON has published a notable book on the Faeroe Islands, where he was stationed during the war years. He is the better qualified in that he married a Faeroese wife.

The Faeroes are a group of islands lying in the North Atlantic between Shetland and Iceland. There are more than twenty islands, covering an area of 541 square miles. Seventeen of the islands are inhabited and the population is 30,000, of which more than 5,000 live in the capital, Tórshavn. The people are of Viking stock, with a culture originally brought from Norway when the islands were settled in the tenth century. Even before they were colonized from Norway, the Faeroes were inhabited by Irish Culdees, who in the ninth century had retreats both on these islands and on the Vestmanna, an island group off the south-west coast of Iceland. It is interesting that there should be a Vestmanna in Faeroe also; the name means Isle of the West-men, as the Culdees were named. Many of the Faeroe inhabitants held positions in Denmark in 1939, and when the Germans invaded Denmark in 1940 a full tenth of the island race were cut off from their homeland.

The Faeroe Islands are mountainous, and most of the land lies at a height of between 1,000 and 2,500 ft. It is rough and rugged country, and on their west sides the hills often fall sheer to the sea from a height of more than 1,000 ft.; here are great colonies of sea birds, of considerable economic importance to the people. The moorlands provide grazing for sheep, and have a considerable proportion of peat, the fuel chiefly used. The chief rock is basalt. The annual rainfall is around sixty inches.

In winter the Faeroe hills are grim and desolate, vexed almost ceaselessly by ocean winds; in March come the golden plover, and the oystercatcher (*tjaldur*), which is the Faeroe national bird, the name of which adorns boats and businesses. The oystercatcher, which appears often on the decorative needlework of the islands, is, like the whimbrel, only a summer visitor to the Faeroes. The author on page 41 gives a fine, poetic description of the song of the whimbrel above the wild island dales. Another migrant, the red-necked phalarope, is welcomed as being the precursor of the herring and is called (p. 84) "herring hen" for this reason.

When sailing in a boat at sea certain names are taboo (this was formerly the case in the Hebrides also). A knife is always 'the sharp one'; a clergyman is called at sea not a parson but *lundi*, the puffin. The Faeroese are great fishermen, and their smacks (p. 88) go as far as Greenland and Bear Island. During the worst period of the War, Faeroe boats brought no less than 75 per cent of the total catch landed in British waters: although the Iceland fishing boats refused to sail without air escort, the Faeroe boats carried on without it. Nearly one third of the active fleet was lost during the war years.

Mr. Williamson describes not only the bird life, but also the customs and folk-lore of the people. On page 234 is a most interesting story of seals laying aside their seals' coverings and assuming human shape. Almost the same story was at one time well known in the Hebridean island of North Uist, and no doubt was brought there by the Norsemen, who ruled the Hebrides until the Battle of Largs in 1263. Summer and the puffin arrive on April 14: between that date and August 24 no light is, or was, used in the houses in the evening, for 'early to bed and early to rise' is the motto in the Faeroe islands.

The book abounds in interesting bird notes and descriptions. On page 121 the bathing parade of kittiwakes to an inland lake throughout the daylight hours is described. This recalls a similar habit I observed on the island of Unst in Shetland. On page 128 is described what must be an unusual habit of Arctic terns, of collecting small fry dropped by puffins at the entrance to their nesting burrows. The puffins are afraid of the terns and scurry into their burrows when these light-winged birds hover near. This reminds me of the habits of the Lambay jackdaws, which during the guillemots' nesting season fare well on the fry the guillemots drop on their ledges. A patrolling jackdaw sees the gleam of the fry, drops down, and carries it off. The puffin is an article of food on the Faeroes. Upwards of 500,000 puffins are captured and eaten annually (p. 145) on the island group, and more than 100,000 young fulmars. They are mostly salted down for winter use. The fowlers believe that the puffin matures slowly and does not (p. 153) come to land the first summer after it is reared. On page 175 an inland-breeding colony of the puffin is noted. The young birds there when ready to leave the nest enter a small river and are carried on its waters during the night hours to the friendly sea.

There is a gannet colony on the Faeroes, and the author (p. 133) records that a gannet ringed there as a bird in down on August 25, 1944, was caught ten weeks later in a fishing net off Agadir, in Morocco. For thirty-four years a black-browed albatross, which won the name 'King of the Gannets' (p. 135), came to this solan colony at Mykinesholmur with the gannets. This bird of the southern hemisphere was shot on May 11, 1894, and the skin is preserved in the Natural History Museum in Copenhagen. On page 140 is given the record of a kittiwake ringed as a nestling on one of the Faeroe cliffs and recovered rather more than three months later off the coast of Newfoundland.

Leach's fork-tailed petrel arrives at its colony later in the evening, after spending the daylight hours at sea (p. 181), than the storm petrel. On page 183 is noted the habit of cats of taking storm petrels. I have known this happen also in the Hebrides.

I have been able to mention only a few of the good things in this book, which will be a delight to all who love Nature, and also to those who wish to learn something of the customs of a fine race of people, strong and self-reliant, and pro-British almost to a man during the darkest days of the Second World War.

SETON GORDON

NATURAL HISTORY OF BRITISH INSECTS

Insect Natural History

By Dr. A. D. Imms. (New Naturalist Series.) Pp. xviii + 317 + 72 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1947.) 16*s*. net.

As a medium for the study of natural history the insects have no equals. The number and variety of their species and the diversity of their habits are such that they afford unrivalled opportunities for the collector, the photographer or the mere observer. The appearance of a general introduction to the natural history of insects in Great Britain prompts some reflexions on the aims and purposes of the amateur entomologist. For British entomology has been built up in the past century and a half by the amateur. To-day there are so many professional openings in entomology that the boy with a consuming interest in insects will probably end by joining the profession. Yet the need for amateur entomology is greater than it ever was. For it is common knowledge that many students now graduate into entomology from the laboratory and the lecture room, with no real feeling for the insect as it exists in the field. It is a curious paradox that it is an ignorant use of insecticides of ever-increasing potency which is forcing the applied entomologist to reflect more and more closely upon the way in which insects live among themselves. It is the avowed purpose of the volumes in the New Naturalist Series to bridge the gap between the scientific worker and the lover of Nature; in the sphere of entomology it is the scientific worker who stands in need of education, at least as much as does the naturalist.

Dr. Imms is singularly well qualified to bridge this gap. He does not attempt a systematic survey of the subject but, in true insect fashion, he collects nectar where he finds it. Wings and flight, senses and behaviour, ordinary and extraordinary habits of feeding, gall formation, the curiosities of insect reproduction, means of protection, aquatic insects and social life—these are some of the subjects, chosen because the author finds them interesting; and it is remarkable how much of the cream of the subject he has taken off. Science is not much use unless it can be brought to the understanding of the ordinary man and incorporated into common knowledge; and it is in the integration of classification, morphology, physiology, ecology and anecdotal natural history that the author has been so successful. The reader will find plenty of anecdotes—often with a pleasant turn of phrase, and without the creaking which is apt to characterize the witticisms of some scientific authors. "If a housefly could keep a diary of its doings it would be a most sordid document" is effective by what it leaves unsaid.

A "Documentary Appendix" is added with the object of guiding the reader to specialist works. This serves to emphasize once more how lacking we are in systematic books on the British insects, so that it is almost impossible for the amateur to make much

headway except with two or three of the most worked orders. It is unfortunate that this appendix contains almost no references to economic entomology apart from those on biological control.

No review would be complete without some reference to the illustrations—forty plates from coloured photographs and thirty-two in half-tone—which are an outstanding feature of this book. Not all are uniformly good, but most are excellent. The coloured 'close-up' of a Capsid bug about to plunge its stylets into a plant (Plate 37) is particularly successful. Some of the coloured illustrations have that disagreeable aniline quality—but the book should be read only by artificial light; then almost all are wholly delightful, and even Plate 5 of *Libellula depressa* is tolerable.

Some typographical errors there are, but not a great many. On Plate 18 the large white butterfly is called *Pieris rapæ*; in Plate 34*b* surely the yellow larva at the top is the prepupal instar of the gooseberry sawfly. As in the other volumes of this series, the editors state that they have done their best to see that the author has got his facts right, but that he alone is responsible for what he says about them. Is this statement really necessary?

V. B. WIGGLESWORTH

ALGEBRAIC GEOMETRY

Methods of Algebraic Geometry

By Prof. W. V. D. Hodge and Dr. D. Pedoe. Vol. 1. Book 1: Algebraic Preliminaries; Book 2: Projective Space. Pp. viii+440. (Cambridge: At the University Press, 1947.) 30*s*. net.

"THIS volume is the first part of a work designed to provide a convenient account of the foundations and methods of modern algebraic geometry." These words from the authors' preface explain the scope of the present volume and account for the selection of topics treated. It has become increasingly clear in recent years that a rigorous treatment of algebraic geometry must be based, to a much greater extent than the classical accounts of the subject, on algebraic principles. It is therefore no occasion for surprise that more than a third of the volume under discussion is purely algebraic. The first four chapters constitute, in fact, a clear and concise introduction to the theory of algebraic fields, polynomials and matrices (over a ground field which is not necessarily commutative). This account is in itself most valuable, since the modern point of view in algebra is not to be found in many English works, though several accounts have been published in the United States.

The next two chapters deal with the foundations of projective geometry, first on an algebraic and then on a purely synthetic basis. A comparison in detail of these two independent formulations of the theory is full of interest. It will be noticed, for example, that the synthetic treatment is much longer. This is due in part to the fact that it starts from abstract axioms, whereas the algebraic development presupposes a knowledge of fundamental algebraic results; but a second and most significant reason is that in the synthetic treatment it is necessary to consider in detail a rather large number of special cases (in themselves of a somewhat trivial nature) in order to assert the validity of general theorems. It is not always sufficiently realized that the apparent elegance and brevity of a synthetic proof of a geometrical theorem may conceal tacit assumptions as to the generality of the figure under discussion which logically demand examination. A novelty in the present treatment, which otherwise follows classical lines (though with unusual care in matters of detail), is that the assumption of Pappus' theorem is deferred until after the introduction of co-ordinates.

The remaining chapters deal with Grassmann co-ordinates (where one would welcome, if possible, the introduction of a more elegant notation), and with the general theory of collineations and correlations, and the reduction of their equations to canonical forms. The geometrical content of the book thus never leaves the domain of projective geometry; the more general birational theory will presumably appear in the second volume.

This treatise is likely to become a standard work. It is notable for its clarity of treatment and for the rigour of its demonstrations, and will repay careful study even in those parts which deal with matters generally considered familiar. The printing maintains the standard that we have come to expect from the Cambridge University Press. J. A. TODD

DISTRIBUTION OF TIME IN BRITAIN

British Time

By Donald de Carle. Pp. 199+47 plates. (London: Crosby Lockwood and Son, Ltd., 1947.) 15*s*. net.

MR. D. de CARLE has assembled a great deal of interesting information regarding the standardization and distribution of time in Great Britain. The majority of people take for granted the accurate time available from such sources as the B.B.C. time signals, Big Ben and 'TIM'. After a brief opening chapter on various early forms of time-keepers, the author deals with the history and present constitution of the Royal Observatory, Greenwich; this chapter brings out the astonishing accuracy with which time is measured and distributed over the radio, and further emphasizes the fact that the pendulum clock is giving way to the quartz-crystal clock when the highest possible accuracy is required.

Reference is made to the facilities for testing watches and the issuing of 'Kew certificates', and in Appendix 2 details of the test and specimen performances of watches obtaining various numbers of marks are given.

Chapters 4 and 5 deal with the development of the clock and the clockmaking industry in Britain, the section on Big Ben serving to emphasize what a redoubtable machine it is, both from the point of view of size and accuracy of performance.

The section dealing with electric clocks contains much information, particularly regarding the development of the Shortt clock, but the description of the quartz clock is unfortunately rather poor.

The chapters on the need for time signals and their history, and the evolution of 'TIM' are of particular interest, and the great amount of development work needed to produce the latter excellent service is given due prominence.

Although the style and lay-out of the book might have been better, it contains a range of information which is not collected together in any other publication, and the book can therefore be recommended with confidence to anyone interested in the subject of time and timekeepers. R. A. FELL

Astronomical Navigation Tables

(Air Publication 1618.) Vol. A: Latitudes 0°–4° North and South. Prepared by H.M. Nautical Almanac Office on behalf of the Air Ministry. Pp. 233. (London: H.M. Stationery Office, n.d.) 7*s.* 6*d.* net.

IN 1936 the Nautical Almanac Office undertook, by agreement with the Admiralty, the preparations of an "Air Almanac" and of "Astronomical Navigation Tables" for astronomical navigation in the air. The "Air Almanac" has always been on sale to the general public; but the "Tables" have been restricted to official use and are now for the first time being placed on general sale.

The complete set of tables comprises fifteen volumes, catering for all latitudes from 79° N. to 79° S. Fourteen of these cover belts of 5° of latitude both north and south of the equator; the fifteenth covers the ten degrees 70°–79°. The tables are designed to facilitate the calculation of the altitude and azimuth of an observed heavenly body. For each degree of latitude and for each degree of hour-angle, the altitude is given to the nearest minute of arc and the azimuth to the nearest degree for each of twenty-two selected bright stars, well distributed over the sky, within the range of altitudes between 10° and 80°, and also for each degree of declination from 28° S. to 28° N., which covers the range of declination for the sun, moon, and planets. The computed altitudes include the effect of refraction at a height of 5,000 ft., but a table of corrections for other heights, from sea-level, for surface navigation, to 40,000 ft., is given.

In order to avoid interpolation with three arguments, the tables are intended to be used with an *assumed* position, corresponding to tabulated values of latitude and of hour-angle. No provision is therefore made for interpolation other than for declination.

The tables are well designed and well printed, and their convenience in practice has been amply proved by their extensive use during and since the War by the Royal Air Force. Though intended primarily for air navigation, they are equally useful for surface navigation, subject to the limitations of accuracy inherent in the tabulations of altitudes to the nearest minute of arc.

H. SPENCER JONES

Regions and Nations of the World

By Assoc. Prof. Earl E. Lackey and Asst. Prof. Esther S. Anderson. Reprint. Pp. xix+489. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1947.) 26*s.* net.

THE authors have here tried to choose what they think most useful for a course in world geography to be given in a year, or abbreviated into a semester, in an American college or university. It requires "few if any additional references or assigned reading to be provided by the instructor"; the reviewer would add here 'more's the pity'. The scheme for each region is (*a*) natural features, (*b*) cultural features leading on to urban centres, and sometimes on to a short appraisal of current problems or of prospects. The book has many illustrations and the photographs are often very telling; the maps are of poor quality. Cultural features are usually notes on commercial and political matters; they vary greatly in appositeness but are sometimes quite to the point, though the accounts of cities are so short as often to be trivial. The book has 100 pages given to the United States and 37 to the rest of North America, 60 to South America, about 140 to the whole of Eurasia, 38 to Africa and 30 to Australasia and Antarctica. The aim is to say something about every region and every country and every really big town, and to follow as uniform a plan as possible, all commendable in a certain measure as facilitating reference to a limited extent; but the book needs vitalizing.

Surely a course of this kind should aim at giving a vision of vital change going on everywhere, a vision that would tempt students who are interested to follow the subject for themselves thereafter. One judges from the text that the writers have not much knowledge of what Edinburgh or Zurich, to take two instances, mean in the human story; but it would be unprofitable to go on with hundreds of instances of missing the point. We must be thankful that geography is being increasingly recognized in the United States and hope that its exponents there may improve on this type of book; so many American books have such high quality already.

H. J. F.

The Psychology of Ego-Involvements

Social Attitudes and Identifications. By Muzafer Sherif and Hadley Cantril. (Wiley Publications in Psychology.) Pp. viii+525. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1947.) 36*s.* net.

THE chief aim of this competent work is to show that the 'ego', or rather the 'ego-involved reaction', is an outcome of social forces impinging upon the individual throughout his life. The authors are deeply versed in the literature of experimental psychology, sociology and social anthropology, and by skilfully weaving together relevant results of research in these fields bring abundant evidence in support of their thesis.

Starting with an analysis of the theory of attitudes and making full use of the important concept of 'frame of reference', they trace the growth of the ego through infancy and childhood and its re-formation in adolescence. This is followed by a valuable treatment of the structural properties of diverse groups in which the participant 'egos' take their shape, and a study of ego pathology in conditions of stress, deprivation and group disintegration. Phenomena brought to light are further illustrated by reference to drama and fiction. Finally, there is a critique of the psychoanalytic theory of the ego, a critique which many readers will think too severe in its conclusions.

The book is a substantial contribution to social psychology. Its robust attention to concrete situations of social life gives it realism without loss of scientific value. As the authors rightly say, scientific objectivity is derived from the methods employed and not from the aloofness of the worker.

JOHN COHEN

Bird Life in Cornwall

By B. H. Ryves. Pp. 256+16 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1948.) 10*s.* 6*d.* net.

LOCAL ornithologies to be of value must be precise, and they therefore tend to become lists; however, Lieut.-Colonel B. H. Ryves in his volume dealing with bird life in the most southerly counties of England has cleverly avoided this by dividing his book into two parts. The first includes an account of Cornwall and its bird haunts and has chapters on such outstanding Cornish birds as the chough, raven, peregrine, common buzzard and Montagu's harrier. In the second part we have a guide to the birds of Cornwall with notes on behaviour, etc. The

whole is admirably illustrated with pen-and-ink sketches by R. A. Richardson, his pintails, showing a duck and drake floating on still water, being a particularly satisfying picture.

As we have said, the early part of the book is that devoted to general observations, and it affords much interesting reading; for example, the account in Chapter 3 of migration movements of sea-birds. The author describes how on March 22, 1932, a warm and sunny day, he watched from Gurnard's Head for five hours an immense stream of birds. "Guillemots and razorbills, the former predominating, kept passing at speed low over the sea in flocks of 100 to 200 birds . . . they were travelling when I came on the scene and still travelling when I was obliged to leave." Gannets, shearwaters and herring gulls also passed, and the author wonders "what was the meaning of this vast 'migrational' movement? The gannets and shearwaters were travelling away from their breeding stations off the Welsh coast." Two other especially interesting chapters are those on the chough—with particular reference to its decrease—and the Montagu's harrier, with its history of the vicissitudes of certain individuals.

FRANCES PITT

The Spell of the Honey Bee

By W. Eric Kelsey. Second edition, revised. Pp. xi+274+49 plates. (London: Chapman and Hall, Ltd., 1947.) 18*s*. net.

THE first edition of this book appeared in 1945 and it was rapidly exhausted. This in itself is a tribute to its merits and that it has fulfilled a need. The author is to be congratulated on the publication of a second edition so soon afterwards and, in his revision, he has taken the opportunity of rewriting the chapter dealing with bee diseases. The book is one of the most attractive bee-keeping manuals we can recall. The essentials of the craft are explained with a freshness of style that is one of the book's special attractions. Also, its value is enhanced by the copious series of half-tone plates, some of which are of exceptional merit. The working drawings of hives and appliances are an additional feature that makes the text easy to follow. Written as a manual for beginners, and with the idea of producing efficient bee-keepers, nevertheless the more experienced will find much that is of interest within its pages. It is obviously outside the scope of the author to discuss the scientific aspects of the bee in any but very general terms and, although he may be a little weak on some parts in this field, the fault scarcely detracts from the merits of the book as a whole.

I Bought a Farm

By Roy Genders. Pp. 112 + 8 plates. (Worcester: Littlebury and Co., Ltd., n.d.) 10*s*. 6*d*. net.

WHEN an author buys a farm and sets about working it for profit, what more natural than that he should proceed to record the ups and downs of his first year's operations for publication. Mr. Genders, released from the R.A.F. after the War, purchased Holly Gate Farm. It was an upland Derbyshire holding of about 78 acres with an ancient but substantial homestead and buildings in a very poor state of repair. In any circumstances a new start in a farm is an anxious business, but the year 1946–47 was a nightmare for any farmer, experienced or otherwise, for one of the wettest harvests on record was followed by a very severe winter. In this book we follow the day-to-day struggle of the author and his two men to make good in the face of great difficulties. A few useful sidelines, such as mushroom growing and dog breeding, made a useful contribution to the enterprise. The story ends on a note of quiet optimism. The account is written in a conversational, almost gossipy style, and will commend itself to the general public rather than to the body of farmers, who will already be familiar with much of the technical information, and will also have experienced all the hazards, hitches and satisfactions there recorded.

Students' Handbook to Fertilizers and Soils

By L. T. Lowe. Edited by G. H. Purvis. (Published for the Monmouthshire Institute of Agriculture.) Pp. 84. (Worcester: Littlebury and Co., Ltd., 1947.) 7*s*. 6*d*. net.

THIS book aims at giving a simple account of the scientific principles of manuring and of soil science suitable for students at farm institutes. It is always difficult to write simple but accurate books in any science that are acceptable to research workers in that science. The difficulty is particularly great in agricultural science, both because the scientific principles of many practical techniques are not too well understood and also because of the great scarcity of clear accounts of the present-day views held by the research workers themselves. Thus lecturers in soil science and crop nutrition in farm institutes and agricultural colleges can justly complain that they are not well served by the research institutes of Britain, and this book unfortunately illustrates the truth of this complaint.

The book suffers in the first place from a brevity so extreme that the choice of topics mentioned appears to be arbitrary, and statements of apparent facts or theories often lack very necessary qualifications. It also, unfortunately, contains a certain number of false statements or obsolete theories. But there are many places in which it gives a reasonable account of some of our present ideas on fertilizer practice and soil science.

E. W. RUSSELL

Poisons: their Isolation and Identification

By Frank Bamford. Second edition, revised by Dr. C. P. Stewart. Pp. viii + 304. (London: J. and A. Churchill, Ltd., 1947.) 21*s*.

THIS is a book which within a relatively small compass gives a vast amount of information. The distinguishing feature of this information is its usefulness. In too many books describing processes of scientific investigation, one finds that some vital detail of technique is not mentioned, and further research is required before the technique can be successfully used. This is not true of 'Bamford'. The details given are adequate for the working out of the processes described and they bear the marks of the author having used them.

The book, however, is not a mere catalogue of toxicological processes, and much information of general interest is given; a particularly good example of this is the short chapter on drugs of addiction.

There is no mention in the section on alcohols of the effect of the passage of time after death on the concentration of alcohol found in the blood. The book is fairly well up to date, although some of the more modern industrial poisons are missing. It is a little surprising to read that chloral has almost gone out of use in modern therapeutics. This is, however, rather outside the author's true scope; within his scope this is a good book.

EDGAR RENTOUL

DIFFRACTION FROM THE IONOSPHERE AND THE FADING OF RADIO WAVES

By J. A. RATCLIFFE
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WHEN a wireless wave is received partly or wholly by way of the ionosphere, it is observed to fade. Much of this fading is due to interference effects between waves which have travelled by different paths. Such waves may include the ground wave, singly or multiply reflected ionospheric waves, waves reflected from different ionospheric regions, or the two magneto-ionic components produced by the presence of the earth's magnetic field. It is, however, possible to isolate and observe only one downcoming wave from the ionosphere, for example, by the use of a pulse sender and a circularly polarized receiving aerial or by the use of a special aerial to suppress the ground wave under conditions when the absorption of the downcoming wave is large enough to make second reflexions unimportant. When only one downcoming wave is observed in this way, it is still found to fade at a speed which varies from time to time. Although few detailed observations of this kind of fading have been reported, workers in the subject will probably accept the general statement that the speed of fading is roughly proportional to the frequency of the wave and inversely proportional to the distance of the transmitter[1].

It is also known that the fading of a single ionospheric wave received at vertical incidence shows some dissimilarity at two points separated by about one wave-length, and from this fact it may be deduced that the wave is returned by a process of irregular diffractive reflexion from an ionospheric region which is considerably inhomogeneous in the horizontal plane[2,3]. It therefore appears more correct to think of the single wave returned from the ionosphere not as one sharply reflected from a smooth mirror, but as a cone of rays returned to the receiver from a diffuse scattering region in the ionosphere, much as light from a street lamp on a bridge might be reflected from an irregularly rippled stream to an observer standing near by. The consequences of this supposition are being worked out by considering the diffractive reflexion from a completely rough surface, and it appears that useful information may be obtained about the 'degrees of roughness' of the ionosphere in this way. It also appears that the amplitudes of waves successively reflected between ground and ionosphere may not be in the ratio expected for 'mirror-like' reflexions, and this fact may have important bearings on the deduction of reflexion coefficients by the usual methods. It is not, however, the main purpose of this article to develop more fully the ideas of the ionosphere as a diffractive reflector, but to suggest that if the roughness of the ionosphere is supposed to vary in a random manner, then the salient phenomena of the fading of a single wave can be explained. The possible causes of the roughness and variability will not be discussed.

To represent a varying rough ionosphere in a simple manner, we assume that there exist several scattering 'centres' distributed approximately in a horizontal plane and that each scatters the same power from the incident wave. The term 'scattering centre' is here used in the sense common in the theory of diffraction, and no attempt is made to define it more precisely. The 'centres' make up the irregularities which form the roughnesses discussed above, and although related to the scattering centres of Eckersley are not necessarily the same. It is assumed that the 'centres' are in continual random motion in such a way that the velocities v in the line of sight are distributed according to a Gaussian law; so that the number $P(v).dv$ of centres with velocity between v and $v + dv$ is given by

$$P(v).dv = A \exp(-v^2/2v_0^2)dv, \qquad (1)$$

where v_0 is the root mean square velocity of a 'centre'. We consider the case of a receiver placed close to a sender emitting pulses of radio frequency f_0 as in the usual method of exploring the ionosphere at vertical incidence. The reflected wave suffers a Doppler shift of frequency after scattering from each of the 'centres', so that its frequency on returning to the ground is given by

$$f = f_0(1 \pm 2v/c). \qquad (2)$$

The phases of the contributions from different 'centres' may be assumed to be randomly distributed, since the 'centres' are at random distances. Powers, therefore, add at the ground, and the resultant electromotive force consists of components of different frequency, the power $W(f).df$ in each frequency-range being obtained by combining equations (1) and (2) to give

$$W(f)\,df = B \exp\{-c^2(f - f_0)^2/8f_0^2v_0^2\}\,df. \qquad (3)$$

For a reason which will be apparent shortly, we may also write this expression as

$$W(f).df = \frac{\psi}{\sigma\sqrt{2\pi}} \exp\{-(f - f_0)^2/2\sigma^2\}\,df, \quad (3a)$$

where $\sigma = 2f_0v_0/c = 2v_0/\lambda$, λ being the wave-length of the wave
and $\psi = \int_0^\infty W(f).df$ = the total power in the wave. (3b)

The fading of the wave is now seen to result from the beating between the component waves of different frequency represented in equations (3). But a series of E.M.F.s with random phases and with powers as given by (3) is *precisely what would result if random noise were passed through a filter the band-pass characteristic of which for power was given by* (3).

Now Fürth and MacDonald[4] have made a detailed analysis of the noise emerging from a filter with a power-pass-characteristic given by equation (3a), which is their equation (12). They have shown first that the amplitude R of the quasi-sinusoidal output E.M.F. is distributed according to a Rayleigh law, so that the probability $p(R).dR$ of finding an amplitude between R and $R + dR$ is independent of the filter and is given by

$$p(R) = (R/\psi) \exp(-R^2/2\psi), \qquad (4)$$

the mean amplitude $\overline{R}$ being given by

$$\overline{R} = \sqrt{\pi\psi/2}. \qquad (5)$$

They also show that the temporal rate of change of the amplitude depends on the characteristics of the filter in the following way. If the amplitude of the output E.M.F. is plotted against time, and if the time axis is divided up into *short* elements τ, and v_τ represents the change of amplitude which occurs during one of these intervals, then the probability

$P(v_\tau)dv_\tau$ of observing a change between v_τ and $(v_\tau + dv_\tau)$ in any one interval is Gaussian and is related to the pass-characteristic of the filter by their equation (19), which states that

$$P(v_\tau).dv_\tau = \sigma \exp\{-(v_\tau/2\pi\sigma\tau\sqrt{2\psi})^2\}.dv_\tau. \quad (6)$$

On our present theory it follows that the fading E.M.F. received from the ionosphere will have these same characteristics, so that it should be described by expressions (4) and (6). My colleague, Mr. S. K. Mitra, has analysed fading curves obtained by observing a single pulse at 4 Mc./s. reflected from Region *F* and received on a circularly polarized aerial and has shown that the results agree well with these equations. This agreement encourages us to believe that the explanation is correct, and to use it to deduce the R.M.S. random velocities of the scattering centres in the following way.

A comparison of the experimental results with equation (6) yields the value of the quantity $\sigma\sqrt{2\psi}$, and since equation (5) relates ψ to the mean amplitude of the received E.M.F. we can determine σ, and hence find v_0 from (3*b*). A typical fading record, analysed in this way, has yielded the value 5 m./sec. for the R.M.S. velocity of the scattering 'centres'.

A little further calculation yields a useful expression for the 'speed of fading'. Fürth and MacDonald[4] define a quantity ε given by

$$\varepsilon = \lim_{\tau\to 0}(\overline{|v_\tau|}/\tau) = \sqrt{2\pi\psi}.\sigma = 2\overline{R}\sigma = 4\overline{R}f_0v_0/c,$$

where $\overline{R}$ is the average E.M.F. In our case we may use the quantity $\varepsilon/\overline{R}$ as a logical measure of the speed of fading, and may then state the position in words as follows.

Let a fading curve in which the amplitude of the received E.M.F. is plotted as a function of time be divided up into short elements of time τ, and let v_τ represent the change in amplitude during the time τ, and $\overline{R}$ the mean amplitude; then the quantity $\overline{|v_\tau|}/\tau\overline{R}$ tends to a limit as τ tends to zero, and is here called the 'speed of fading', *S*. It is related to the velocities of the scattering centres by the expression

$$S = \overline{|v_\tau|}/\tau\overline{R} = 4f_0v_0/c = 4v_0/\lambda. \quad (7)$$

It is at once apparent that the speed of fading is proportional to the frequency of the radio wave, in agreement with the facts mentioned at the start of this article.

If we had to do with only two scattering centres, one of which remained stationary and the other moved in the line of sight with velocity v_0, then we should record a complete cycle of fading in a time t such that $1/t = 2v_0/\lambda$. Equation (7) shows that the 'speed of fading' (*S*) in the case of several centres moving at random yields a quantity of the same order of magnitude.

In some experiments being made in Cambridge, the phase variations in a single downcoming wave are being studied, and it is of interest to consider what may be deduced from them. These phase variations are likely to be of importance in direction-finding and in radio navigational aids. If the downcoming wave is composed of contributions from several moving scattering 'centres', the phase φ will vary in a random manner, and a record of φ plotted against time may be analysed by dividing it up into short equal intervals τ, in which φ changes by $\Delta\varphi$, and evaluating the quantity $\lim_{\tau\to 0}\overline{|\Delta\varphi|}/\tau$, which may be called the 'average rate of change of phase'. We should expect this quantity to be simply related to the corresponding rate of change of phase $(2\pi.2v_0/\lambda)$ produced by reflexion from a single 'centre' moving with the velocity v_0 in the line of sight, and I am indebted to Dr. D. K. C. MacDonald for a proof that, in fact, the two quantities are equal. Dr. MacDonald has also shown how the probability of obtaining a value of $\Delta\varphi$ is related to $\Delta\varphi$ and has provided a theoretical expression with which measurements can be compared.

I have been able to examine records of the phase-variations of a single downcoming wave from Region *E* made on 2 Mc./s. by Mr. J. W. Findlay and on 100 kc./s. by Mr. K. Weekes, both working in Cambridge. The method used by Mr. J. W. Findlay has previously been described and a sample record illustrated[5]; the only records amenable to analysis are those of the simpler type illustrated in his Fig. 3. Mr. Weekes uses a method which has not yet been described. For both these frequencies I find that the probability distribution of the quantity $\Delta\varphi$ agrees fairly well with the expression of MacDonald. For the frequency of 2 Mc./s., the R.M.S. velocity deduced for the 'centres' is 0·5 m./sec. and for 100 kc./s. it is 1·0 m./sec. These orders of magnitude are consistent with that deduced from Mr. Mitra's analysis of the amplitude of fading on 4 Mc./s.

I have also been able to examine some measurements of the phase and amplitude of the downcoming wave observed at nearly vertical incidence by Mr. R. N. Bracewell on 30 kc./s. and 16 kc./s. These measurements have been made by an extension of the technique described by Best, Ratcliffe and Wilkes[6] and Budden, Ratcliffe and Wilkes[7]. On these frequencies the refined techniques now in use frequently show the occurrence of a relatively rapid variation of phase and amplitude superimposed on a slower variation. If the results are first smoothed so as to remove the more rapid variation (phase changing at the rate of about 2π in 5 min.), it is possible to analyse both the phase and amplitude records in the manner previously explained. Although the smoothed fading is then so slow (phase at the rate of about 2π in 1½ hr.) that the probability distribution cannot be checked in any detail, there is no obvious disagreement with the theory, and the mean values for the speed of amplitude and phase fading both lead to the same value, approximately 1·0 m./sec. for v_0. There appears to be no counterpart, on the higher frequencies, to the more rapid fading observed on these very low frequencies.

We have seen that observations at nearly vertical incidence on frequencies from 4 Mc./s. to 16 kc./s. yield results of the same order for v_0, provided we smooth out the more rapid fading on the very long waves. This agreement is indirect proof of the statement made at the start of this article that the rate of fading is proportional to the wave-frequency. It is next of interest to consider the phenomena associated with oblique transmission through the ionosphere.

By considering how a movement of a scattering centre affects the length of path of waves scattered from it at oblique incidence, it can be shown that the speed of fading should be roughly inversely proportional to the distance of transmission, provided that this distance is greater than the height of the

reflecting region. Mr. R. W. McNicol has kindly made an analysis for me of some fading curves of distant broadcasting stations, provided through the courtesy of the B.B.C., and has shown that they can be explained in terms of scattering centres moving with random velocities of the same order as those deduced from the experiments made with vertically incident waves.

Up to this stage in the discussion we have assumed that the Doppler shift in the component waves occurs during backward scattering from moving 'centres' *situated in the reflecting region*. If, however, a wave, reflected from a given region (1), passes through an irregular region (2) below, then it will suffer diffraction at region (2), and if the scattering elements in region (2) are in motion, the diffraction pattern at the ground will vary with time, and an observer at a fixed point will notice that the wave 'fades'. The matter is complicated because the wave traverses the diffracting region twice, once on the upwards and once on the downwards journey; but the nature of this fading can be deduced, to a first approximation, by considering the Doppler shift due to the forward scattering from the scattering centres in region (2), and the results are then somewhat dependent on the assumptions which are made about the motions of these centres. The general trend of the calculations is the same as before, but the Doppler shifts are smaller for the same velocities.

Useful information should be obtainable by making simultaneous observations on the fading of single echoes from Regions *E* and *F*. If the fading of echoes from both regions were due to the movements of reflecting clouds in the appropriate region, then we should expect the application of the analysis given in detail in this article to apply to each echo separately, and to give an R.M.S. velocity v_0 which would probably not be the same for both. If, however, the fading of both echoes were due to inhomogeneities in an absorbing region below both reflecting regions, then the fading of both echoes should be explicable in terms of the same velocities in the absorbing region, provided we used the type of analysis applicable to transmission *through* a diffracting region. If the fading of the echo from Region *E* were due to backwards scattering from moving elements of that region, whereas the fading of the echo from Region *F* were due to the fact that it had passed through the irregular Region *E*, then we should have to use different types of calculation for the two echoes in order to get concordant results for the R.M.S. velocity v_0. These possibilities are being tested.

Although the theory outlined in this article is only meant to be a first approximation to the truth, it is nevertheless thought to contain the essence of the explanation of the fading of a single echo. Obvious extensions of the theory include the consideration of:

(*a*) A steady component of E.M.F. reflected from a constant and uniform part of the ionosphere in addition to that returned from the scattering centres. This will give rise to effects similar to those obtained when a steady E.M.F. is added to the output of a Gaussian filter-passing noise, and the analysis will follow that of Fürth and MacDonald for this case.

(*b*) 'Centres' which do not all scatter equal powers, and 'centres' the scattering effect of which varies with time.

(*c*) Velocities of the centres which are not distributed in a Gaussian manner.

(*d*) Different velocities in the horizontal and vertical directions.

(*e*) The possibility that, if the 'centres' are embedded in a region where the refractive index is considerably less than unity, the Doppler effect will be less than that indicated, so that the value of v_0 will be greater than that calculated here.

In conclusion, it may perhaps be pointed out that there are obvious analogies between the reflexion of a radio wave from randomly moving scattering 'centres' and the radiation of monochromatic light from a series of molecules moving with random heat motions. The broadening of the spectral line in the optical case is analogous to the spread of frequencies in the radio case, and if the light could be observed sufficiently rapidly it would be found to be fading, just as the radio E.M.F. fades.

I am indebted to my colleagues mentioned above, who have kindly put their observations at my disposal. Their researches are supported by a grant from the Department of Scientific and Industrial Research. I am also indebted to Dr. MacDonald for help with the analysis of phase.

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SOME COMPONENTS OF THE LYTIC SYSTEM OF GRAM-POSITIVE MICRO-ORGANISMS

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FOLLOWING certain pioneer work and suggestions by our former colleague, Dr. H. Henry, it was apparent that much information regarding the structure of Gram-positive bacteria and their behaviour when acted upon by antibiotics could be obtained from a study of bacterial autolysis. The few detailed studies of autolysis which have previously been made have been mainly confined to the pneumococcus group. Goebel and Avery[1] showed that the autolytic disintegration of pneumococci was accompanied by proteolysis resulting in an increase in both amino-nitrogen and non-coagulable nitrogen, and by lipolysis liberating ether-soluble fatty acids. A non-specific cell-free autolytic enzyme system acted upon heat-killed pneumococci to give results comparable with those from spontaneous autolysis and also brought about the partial lysis of suspensions of heat-killed *Streptococcus viridans*[2].

In confirmation, Dubos[3] further made the significant observation that before lysis of the cells occurred the cocci first became Gram-negative, and this change in the Gram staining reaction was not necessarily associated with complete lysis of cells. It was possible, moreover, to effect this change in the Gram-staining reaction of heat-killed, Gram-positive penumococci by the action both of pancreatic ribonucleinase[4] and a ribonuclease-like 'tissue enzyme' isolated from rabbit leucocytes[5] (cf. Bartholomew and Umbreit[6]).

In our hands, these and other enzymes, for example, from the lower fungi, have been found to render Gram-negative a range of heat-killed Gram-positive micro-organisms. The change in the Gram-staining reaction appears to be brought about only by enzymes of the ribonucleinase type, that is, those which hydrolyse ribonucleic acid to the four mononucleotides[7]. We have found by way of contrast that preparations of intestinal phosphatase and of a phosphatase from dog fæces[8], although able to hydrolyse free yeast ribonucleic acid with the liberation of inorganic phosphate, had no action upon heat-killed Gram-positive cells.

Extension of our investigations to bacterial autolysis has shown that it is possible to divide the cellular disintegration of most Gram-positives into two separate and distinct stages, namely, (*a*) the change from Gram-positive to Gram-negative, and (*b*) the subsequent lysis of the Gram-negative cytoskeletons. We have so far recognized four distinct enzyme systems involved in the cellular disintegration. The extent to which the two stages occur in suspensions of autolysing Gram-positive cells depends sharply upon the *p*H and upon the oxidation-reduction potential of the system. For bacterial autolysis, there appears to be an optimum *p*H for each species which varies from *p*H 5 for certain sarcinæ to *p*H 8 for clostridia and some staphylococci. Our colleague Dr. Henry made the striking observation that, under reducing conditions, only the first stage of autolysis occurs, and this results in the formation of Gram-negative cytoskeletons which do not undergo further digestion at any *p*H less than 7. By carrying out autolysis in the presence of suitable reducing agents, such as hydrogen sulphide or thioglycollic acid, it was found possible to obtain in solution and free from the enzymes concerned with complete cellular disintegration, the enzyme system responsible for the initial stage of autolysis. Detailed studies of the properties of 'initial stage' enzymes from both *Cl. welchii* and *Staph. citreus* have shown that the two are closely similar. They have in common the property of hydrolysing free yeast ribonucleic acid but not deoxyribonucleic acid, while they differ in several respects from the ribonucleinase of animal tissues[4]. Thus they have *p*H optima at 7–8, are inactive at *p*H 4·0, are activated by reducing agents and inhibited under oxidizing conditions. Irreversible loss in activity occurs when the enzyme solutions are heated at 80° for 30 min., whereas at 60° any inactivation is dependent upon the *p*H and the time of heating, the enzymes being most stable at *p*H 8.

Although the enzymes from *Cl. welchii* and *Staph. citreus* both have the property of hydrolysing free ribonucleic acid, they are species specific, and indeed to some extent strain specific, in their action on heat-killed Gram-positive cells. Thus, the enzyme from *Cl. welchii* readily converted heat-killed Gram-positive *Cl. welchii* to Gram-negative cytoskeletons, but had no action on heat-killed Gram-positive *Staph. citreus*, *Staph. aureus* or *Lactobacillus helveticus*. Similarly, the enzyme from *Staph. citreus* exhibited no action on the Gram complex of heat-killed Gram-positive *Cl. welchii* or even of *Staph. aureus*, but was active against a rough variant isolated from an aged culture of *Staph. aureus*. As the smooth–rough transformation is known to involve the loss of the ability to synthesize certain bacterial polysaccharides, the latter observation suggested that the specificity of these bacterial enzymes was in some way connected with the specificity of the polysaccharides of the cell.

Recent studies on the action of lysozyme[9] have shown that ribonucleic acid and the specific polysaccharides of Gram-positives are presumably in combination at the cell surface. When heat-killed Gram-positive cells are incubated with lysozyme, certain carbohydrate linkages are disrupted, the Gram staining reaction becomes negative and undegraded ribonucleic acid and polysaccharides are released into solution.

Further, specific polysaccharides of staphylococci and of *Cl. welchii*, isolated by procedures which did not destroy cellular structure, also were found to be hydrolysed to a small but definite extent by the action of lysozyme.

Since these same polysaccharides were not acted upon by the initial stage bacterial nucleinases, the latter appeared to be essentially free from lysozyme. However, it was shown that, during the action of these enzymes in the autoconversion of Gram-positives to the Gram-negative cytoskeletons, a small percentage of reducing groups was released and specific polysaccharides were liberated in an apparently undegraded state into solution (cf. a similar observation by Dubos[10] during pneumococcus autolysis). We conclude that the initial stage in the autolysis of Gram-positives involves an enzyme, highly specific in its action, which breaks the relatively labile linkage joining the specific polysaccharide and the ribonucleic acid. Such enzymic activity is probably possessed by most preparations of animal ribonucleinases, and renders the Gram ribonucleoproteins[11] of the cells susceptible to the subsequent action of ribonucleinase. The latter breaks down the ribonucleic acid component to the mononucleotide stage, but does not disrupt the Gram-negative cytoskeleton.

All procedures which were found to inhibit the change in the staining reaction of Gram-positives to Gram-negatives also inhibited the ribonucleinase activity of the enzyme solution, and the variation in the activity of different enzyme preparations against killed cells was accompanied by a parallel variation in ribonucleinase activity. However, the fact that ribonucleic acid removed from one Gram-positive organism by extraction with sodium cholate may be replated on to the reduced Gram-negative cytoskeletons of a second extracted Gram-positive cell[11] would suggest that the bacterial ribonucleic acids themselves do not show any fundamental structural differences. This may account for the less specific nature of ribonucleinases, and suggests that the marked degree of specificity shown by the bacterial enzymes responsible for the conversion of Gram-positives to Gram-negatives is due to a 'polysaccharide-releasing' enzyme.

When the autolysis is rapid and less carefully controlled[12], the linkage between the nucleic acid and protein of the cytoskeleton may not be broken, and a certain proportion of the Gram-positive ribonucleoprotein is released into solution[12], so that the linkage between the nucleic acid and the protein, probably involving —S—S— linkage[11], is essentially firmer under certain conditions.

When a suspension of suitably prepared Gram-negative cytoskeletons is adjusted to *p*H 8, complete lysis rapidly follows. We have succeeded in isolating closely similar lytic enzymes from the cytoskeletons of *Staph. albus* and *Staph. citreus*. From both, preparations of two proteolytic enzymes were isolated, one of which hydrolyses casein but not peptone, and a second which hydrolyses peptone but not casein.

It was shown that the initial disintegration of the cytoskeletons is due to the action of the casein-hydrolysing enzyme. The protein fragments which result from this cellular disintegration appear to be further hydrolysed by the action of the peptone-hydrolysing enzyme.

In contrast to the enzymes responsible for the first stage (*a*) of bacterial autolysis, these proteolytic enzymes are not specific in their action and readily dissolved the Gram-negative cytoskeletons of all Gram-positives examined and also heat-killed true Gram-negative bacteria. They had no action on heat-killed Gram-positive cells, and it was concluded that these proteolytic enzymes do not play any part in autolysis until the cells have become Gram-negative.

In extension of these studies[12], we have shown that some *Actinomyces* cultures under certain conditions possess a system composed of a lipoidal bactericidal substance, a ribonucleinase and proteolytic enzymes. We have obtained evidence that such a system is also present in a culture filtrate of *Pseudomonas pyocyanea* and in certain moulds which are antagonistic to bacterial growth. It would appear, therefore, that such a system may be of fundamental importance in the general phenomenon of bacteriolysis and may also have some bearing on the nature of phagocytosis. In the latter case, it will be recalled that leucocytes are known to contain an enzyme which hydrolyses ribonucleic acid[5] as well as proteolytic and other enzymes.

The precise role of lipases[1] and deoxyribonucleinases[14], said to be present also in Gram-positives, is under investigation.

We are grateful to Dr. H. Henry and Dr. A. S. Jones for considerable help and to the Medical Research Council for a grant.

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SOIL CONSERVATION

THE Food and Agriculture Organisation of the United Nations Organisation has recently published a beautifully produced booklet entitled "Soil Conservation—an International Study" (Washington, D.C.). It comprises 190 pages, of which about half are occupied by pictures. Thus the problems of world soil conservation are covered in about a hundred pages of text. The idea behind the publication appears to be to appeal to politicians, administrators and publicists without whose co-operation the urgent need for soil conservation may be overlooked until too late. These will get the impression that soil conservation is an American invention. It is not an entirely false impression, but there are countries—for example, Japan and Java, and, for that matter, Great Britain and others—in which soil conservation is so highly perfected that the 'problem' of soil conservation scarcely exists, and the achievements of these countries in adapting their methods of land utilization to the environment have consequently been overlooked. The authors of the booklet admit that "much attention has been given to China and the United States of America"; but it would be more accurate to say that the United States gets 75 per cent of the space, China 10 per cent, and the rest of the world 15 per cent. It is worth quoting all that this leading international agricultural authority has to say on physical losses from the mismanagement of farm lands in the world outside the United States, China and Latin America. Under the heading "Other Countries", it is stated: "All over the world, wherever man has cultivated sloping land, there has been soil erosion in some degree. In the Mediterranean region of Europe, in Asia, in North Africa, in tropical Africa and South Africa, and in India its results have been described, but little measurement has been made of its extent or severity." One of the results in India that "have been described" is far more human misery than soil erosion has caused in the whole of the United States. Australia and New Zealand are other countries that appear to have been overlooked.

There is some justification for this one-sided approach. Modern methods of soil conservation used all over the world and the principles of planning land utilization to suit the land have nearly all been developed in the United States, which are in advance of most other countries not only in the application of mechanical measures and in the adaptation of land utilization to soil conservation, but also in appreciation of the social and economic consequences of the adoption of soil conservation. But the achievements of soil conservation in the United States tend to blind people there to the lesser, but certainly not negligible, achievements of countries which have not the money, the men or the means to accomplish what the United States have done. The book leaves the impression that the authors have used the material immediately available in Washington, but have not troubled to look further afield. Something better is expected of an international study with the imprint of the Food and Agriculture Organisation.

The fact that about the only reference to soil conservation in the British Empire is the statement that British settlers have given much attention to pasture development suggests that there were not many representatives of Empire agriculture available in Washington while the book was being prepared. The countries of the British Empire have less to show in the conservation 'shop window' than the United States, but they have a lot in the 'shop' itself. The forest and agricultural departments of India did a magnificent piece of work in face of tremendous difficulties in checking the devastating erosion in the foothills of the Himalayas and elsewhere, much but not all of which was of recent origin. India has a problem of peculiar difficulty—over-population. This has led to a growing recognition of the fact that the welfare of the land is a communal rather than an individual responsibility, and to communal schemes of integrated soil conservation. The successful adaptation of the *taungya* system, to which the Food and Agriculture Organisation book only refers in passing, to purposes of soil conservation had already reached a high degree of development some decades ago. The Indian Forest Service has a

reputation second to none for applying soil-conservation measures.

Australia, New Zealand and South Africa have learnt much in recent years from the United States, and with varying success have adapted American principles of soil conservation to their particular circumstances. The mechanics of soil conservation—that is, the prevention of water and soil from running downhill—are essentially the same everywhere; but environmental and social conditions in different regions require that soil-conservation measures should be integrated in different patterns. The art and science of soil conservation consist in building up a pattern of land use that will fit the physical, economic and social environment. All three Dominions have adopted the idea of the American soil-conservation district as the social unit for soil-conservation planning, but in different forms. It is still too early to say with how much success their plans will ultimately be crowned, but these embryonic experiments in applied human ecology deserve most careful attention.

In the British Colonial territories, too, the problems of soil conservation peculiar to tropical conditions are being tackled with increasing vigour and imagination. Whereas until recently most territories relied mainly on mechanical methods of erosion control, there is to-day a general awareness that these are only a means to an end, and that soil conservation must be integrated into systems of husbandry that will enhance the fertility of the soil. A few years ago the goal of many Colonial agricultural policies was at best to maintain soil fertility. Now it is to increase fertility; and with increased fertility should come increased stability, both of the soil and of society. This latter goal is still far from attainment; but those who control British Colonial policy seem to be gradually awakening to the importance of fundamental scientific studies for the conservation of the tropical environment. The work of W. S. Martin, who showed that grass fallows could have a dramatic effect on the restoration of soil fertility, the improvement of soil structure and resistance to erosion, promises to revolutionize the basis of arable agriculture in East Africa. Attention is also being paid to methods for improving pastures and controlling grazing, and to the proper role of fire in tropical agriculture. Many of these problems require expert knowledge of the structure of native societies for their solution.

To be effective, conservation measures in the tropics, as elsewhere, have to be applied on a regional scale, which involves co-operative or communal action, and may involve drastic modifications in land utilization. One of the great difficulties in the Colonies has been to secure co-ordinated action throughout a region. Responsibility for the welfare of the land is divided among many authorities whose interests do not always coincide. There is, indeed, need for conservation education and propaganda not only among native and European farmers, but also at high administrative levels. Native peoples, in Africa at any rate, often have a tradition of communal land ownership that should facilitate the enforcement of legislation designed to secure effective co-operative action in the control of soil erosion.

Several British Colonies and Protectorates have already enacted legislation to enforce soil-conservation measures or to regulate land use and conditions of land tenure for the purpose of conserving the soil. The trend of recent legislation has been towards the setting-up of regional authorities on the pattern of the American soil-conservation districts. Indeed, the invention of the soil-conservation district is probably America's greatest contribution to the promotion of soil conservation throughout the world. The authors of the Food and Agriculture Organisation booklet, with unnecessary modesty, make little reference to it; though they do state the astonishing fact that within the last ten years more than 1,000,000,000 acres—more than half the total land area of the United States—have been brought under the control of soil-conservation districts. G. V. JACKS

THE COLONIAL MICROBIOLOGICAL RESEARCH INSTITUTE, PORT OF SPAIN, TRINIDAD, B.W.I.

IN 1945 Sir Robert Robinson and Prof. J. L. Simonsen, acting on behalf of the Colonial Products Research Council, paid a visit to the West Indies to acquaint themselves with the tasks in which scientific research could assist these and other tropical territories of the Commonwealth. From the observations they made in the Colonies which they visited, they concluded that almost every branch of science could be called upon to take a share in raising the prosperity of these lands; but that a special claim could be made for microbiology, of which only the most urgent medical aspects had been receiving attention in the past.

The Colonial Office accepted their conclusions and made funds available for the foundation of a Colonial Microbiological Research Centre to be situated within the tropics.

Port of Spain, Trinidad, was decided on as a suitable location. It was approved that the centre should devote its energies to fundamental research in microbiology; to the application of the results of its investigations; and to assisting agricultural and other industries in improving their products. Further, it was approved that the new Institute should form a centre for postgraduate training in microbiology. Afterwards, it was decided that a branch of the new centre should devote itself to the maintenance of a collection of micro-organisms which could be made freely available to interested institutes and to research workers in tropical and temperate climates.

To meet the needs of the new centre a building was designed, which, in addition to a library, comprises six laboratories, three for microbiological and one for biochemical research. One laboratory is reserved for the type culture collection, and one for the preparation of culture media.

A special room is provided for the cleaning and sterilization of glassware. Adjoining, and communicating with, the biochemical laboratory is a balance room; another room is provided for photomicrographic work, in which an electron microscope may eventually be set up, should this prove desirable. For the cultivation of micro-organisms requiring temperature of 18° C. and below for maximum growth, a special room has been provided, which is maintained constantly at this temperature. In addition, the building houses three offices, a cafeteria, a first-aid room and a store-room.

The whole building is air-conditioned and will be maintained at a temperature of 25·5° C. (78° F.) and

a relative humidity of 60 per cent. The air-conditioning plant is housed in a penthouse on the roof of the one-storied laboratory building.

Since some of the investigations which the new centre is expected to undertake may eventually be adopted by industry, it was felt to be important to incorporate a pilot plant in the design of the institute. The pilot plant, when completed, will house, in addition to a complete fermentation plant of 400 gallons capacity with a separate distillation unit, a boiler house, a gas plant, an air compressor unit and a machine shop. From the pilot plant, gas, steam and compressed air will be supplied to the various laboratories, through underground pipe systems. All equipment for the pilot and air-conditioning plants are of British design and manufacture.

In view of the acute housing shortage throughout the West Indies and in Port of Spain in particular, it was agreed that housing facilities should be provided for the scientific staff within the grounds of the Institute. To this end a block of four flats has been erected within the six acres of grounds belonging to the Institute. A bungalow for the engineer has also been erected there.

The construction of the various buildings was commenced early in 1947 and has by now progressed so far that the Institute is to be opened officially on July 5, when Lord Hankey, chairman of the Colonial Products Research Council, has consented to perform the ceremony in person.

Invitations to attend the ceremony have been sent to Governments of the various Colonies, to Governments with Colonial possessions in the tropics and to the Governments of the neighbouring Central and South American States.

It is hoped to make the opening an occasion for informal discussions, among the delegates, of microbiological problems, particularly such problems as are met with under tropical conditions.

OBITUARIES

Prof. W. T. David

THE sudden death on May 22 of Prof. W. T. David has removed from the University of Leeds a man of real distinction with a vivid personality. For twenty-six years he was professor of engineering and administrative head of the Engineering Departments.

David was born in Laugharne in 1886 and was educated at St. David's County School. After a brilliant career at University College, Cardiff, he went to Trinity College, Cambridge, where he specialized in a study of infra-red radiation from flame gases and related combustion phenomena under the inspiration of the late Prof. B. Hopkinson. This field of research ultimately became his abiding interest. In 1912 he was appointed H.M. Inspector of Schools on the technological side; during the First World War he became inspector of gun ammunition with headquarters at Woolwich Arsenal and later director of dilution of labour at the Ministry of Munitions. In 1920 he was appointed to the chair of engineering at University College, Cardiff, and in 1922 he succeeded the late Prof. John Goodman in the chair of engineering at Leeds.

David was no narrow scholar, and was a strong advocate of education in the true university sense. He was a man of high integrity and sound judgment, and his brilliance, kindness and wisdom endeared him both to colleagues and students. He freely gave to all students and encouraged them to high endeavour by his inspiring teaching and the impact of his personality. In his lectures he would stress the importance of grasping the fundamental principles of engineering science, revealing the basic concepts in brilliant flashes, and would carefully lead the student in some branch of the subject on to the very frontiers of knowledge. David frequently likened this method of lecturing to students to taking them to the top of Mount Pisgah to view 'the promised land', so that with few words he would excite and fire the imagination of the students and make a lasting impression upon their minds.

In the field of research David directed his efforts mainly towards the problems of combustion phenomena and the related problems of internal combustion engines. At Cambridge he took special interest in heat loss from gaseous explosions, and he became intrigued with the problem of 'missing-pressure' in internal-combustion engines. This resulted in a comprehensive study of explosions of inflammable gaseous mixtures at a time when the lack of reliable thermal data handicapped his investigations. His intuition, however, led him to believe that flame gases were not really normal hot gases but possessed energy in excess of that of normal gases. The development of quantum mechanics and afterwards the provision of thermal data have made it possible to confirm his early ideas concerning flame gases. No one was more devoted to his subject or to his students.

Outside the University of Leeds, David was known in engineering circles in Yorkshire and elsewhere; was a member of the Institutions of Civil and of Mechanical Engineers, and was chairman of the Yorkshire Association of the Institution of Civil Engineers for the session 1928–29.

David was a man whose views were highly valued in any assembly and his contributions to discussion, often brief and pungent, were commonly wise. He possessed an independent mind and a forceful character, "it's dogged that does it" being his motto. He will be sorely missed for his clear judgment, store of good humour and warm sympathy, especially at a time like the present, when the transition to peace and the expansion of the University of Leeds are raising so many problems. R. H. EVANS

Dr. A. E. Jones

DR. ARTHUR EMRYS JONES, lecturer in mathematics at the Imperial College of Science and Technology, London, was killed in a lift accident on May 7 at the age of twenty-seven. A scholar of St. John's College, Cambridge, he secured a first class in Part II of the Mathematical Tripos in 1939, and honours in Part III in the following year. During the War he worked in the Ballistics Section of the Armaments Research Department, and was associated with J. R. Womersley in his pioneer work on the application of statistical methods to the control of variability in gun-cordite. In 1945–46 he worked at Rothamsted Experimental Station on the design of grazing experiments, and thereafter entered the Statistics Section of the Mathematical Department at Imperial College.

A thesis on continuous stochastic processes and autocorrelation theory brought him his doctorate in 1946. He had also published, in *Biometrika*, vol. 33, Part IV, a paper on the routine estimation of dispersion from large samples. At the time of his death

he was working on the effects of autocorrelation on experimental design and estimation. A paper on this subject, by him, will be published shortly by the Royal Statistical Society.

What advances in mathematical statistics Dr. Jones would have made, had he lived, cannot be known. What is certain is that they would have been considerable. He leaves a wife and daughter.

WE regret to announce the following deaths:

Jacques Cochon de Lapparent, *Correspondant* of the Section of Mineralogy of the Paris Academy of Sciences, on May 18, aged sixty-five.

Mr. C. A. Malcolm, C.I.E., during 1928–34 chief conservator of forests, Central Provinces, India, on June 8, aged sixty-eight.

NEWS and VIEWS

Imperial College of Science and Technology: Sir Richard Southwell, F.R.S.

IN September 1948, Sir Richard Southwell relinquishes the rectorship of the Imperial College of Science and Technology, London, after a period of tenure of six years. This step he has decided to take in order to be free to carry through various research projects concerned with the methods of relaxation that have become so closely associated with his name. Six years is but a short time in which to leave an imprint on the policy and development of an institution of the magnitude and scope of the Imperial College; but there is no doubt that his influence has left its distinctive mark. During this period detailed plans have been produced for the reconstruction of the three constituent colleges on a formidable scale; and if, for reasons of national exigency, these plans will not mature during this quinquennium, they are at least ready to be transformed into reality as soon as the opportunity arises. Not unconnected with this has been the celebration of the centenary of the first beginnings of the College, and the opportunity it presented of establishing a fund that will make possible many ventures of a social and educational nature that would have been otherwise cramped or completely frustrated. Moreover, a commencement has been made with the extension of hostel accommodation for students by the foundation of Selkirk Hall. In this period also the representation of the staff on the governing body has been enlarged, so that members of the teaching staff are involved to a much greater extent than heretofore in the determination of College policy. In this connexion also Sir Richard Southwell has been responsible for the extension of deanships to the three constituent colleges, a move that has made for much closer co-ordination and collaboration than hitherto. On the side of educational policy, he has been mainly responsible for the distinct shift in the incidence of College studies, whereby further developments in advanced study and research are coming into prominence while some of the more elementary preparatory work is fading out. Finally, he has unquestionably built up a tradition of social life that is not usual or easy to develop in a college situated in the metropolis. Sir Richard Southwell can now withdraw from the hurly-burly of the administration of the College with the sure knowledge that during his six years he has helped to determine much of its future character.

Chemistry at Birmingham: Sir Norman Haworth, F.R.S.

SIR NORMAN HAWORTH, who has held the Mason chair of chemistry and the directorship of the Chemistry Department in the University of Birmingham since 1925, is to retire from office at the end of the present session. He studied at the Victoria University of Manchester and, after periods spent in Germany and at the Imperial College of Science and Technology, London, he proceeded to St. Andrews as lecturer in organic chemistry. From there he went to Armstrong College, Newcastle (University of Durham), as professor of organic chemistry (1920), and five years later he was elected to the Mason chair at Birmingham in succession to Sir Gilbert Morgan. Under Haworth's leadership the research school at Birmingham rapidly became the chief centre for structural investigation in the carbohydrate group, and the importance of his contributions in this field was recognized by the award of the Nobel Prize for Chemistry (1937). In addition to the direction of a large research school which has attracted workers from all over the world, Sir Norman Haworth has contributed greatly to developments in teaching methods and to the organisation of his department. He has held office as dean of the Faculty of Science and as vice-principal of the University of Birmingham and has served on many Government boards and committees. He is a Longstaff medallist of the Chemical Society, of which he was president during the years 1944–46. He is now a vice-president of the Royal Society, from which he has received both the Davy Medal and a Royal Medal.

In the earlier part of Sir Norman's period of office, the work of the Birmingham school was directed mainly to the determination of the structures of the simpler sugars and their derivatives. For example, the difficult problem of the ring structures in sucrose was solved, and an elegant method, involving oxidation to the aldonic acid, followed by methylation, was developed for determining the structure of reducing disaccharides. Studies were made also of acetone derivatives, sugar carbonates, anhydro sugars, partially methylated sugars and other important reference compounds; and, on the broad and firmly established basis thus laid down, the investigations were extended to the naturally occurring polysaccharides. There followed the elucidation of the general type of structure present in the macromolecules of cellulose, starch, glycogen, inulin, xylan, mannan and certain levans, and the introduction of methods for the assay of terminal groups enabled still further insight to be gained into the detailed molecular architecture of the polysaccharides. Along with these developments should be noted the determination of the structure of vitamin C and its synthesis, and the elucidation of the structures of glucosamine and chondrosamine. More recently the attention of workers in the Birmingham school has been directed towards biochemical problems, and important discoveries have been made concerning the enzymic degradation of the components of starch and their synthesis from glucose 1-phosphate. Investigations are in progress also into the structure of the highly important bacterial polysaccharides.

Prof. H. W. Melville, F.R.S.

Prof. H. W. Melville, who will succeed Sir Norman Haworth at Birmingham, has made many valuable contributions to our knowledge in the field of reaction kinetics. His early work consisted in the examination of the various explosion limits in such mixtures as phosphine and oxygen. The implications of the free radical in such reactions led him to explore the mechanism of a number of photochemical reactions in which radicals are found, and here he first introduced the device of the rotating sector which has permitted us to obtain life-times of transient species with remarkable accuracy.

Some fifteen years ago when deuterium and its compounds became readily available, Melville examined a number of gas reactions in which hydrogen could be replaced by deuterium in order that the relative importance of mass and zero-point energy could be evaluated, thus throwing light on the detailed mechanism. With this background Melville felt that he was in a position to take up the suggestion that the study of the more complex processes of polymerization and macromolecular condensation might, if carried out in the gaseous phase, yield valuable information on the nature of the chain reactions involved. He threw himself into this work, both in the Department of Colloid Science at Cambridge and later at the University of Aberdeen, with his characteristic energy, and the continuous stream of papers in this field coming from these laboratories bears witness to his versatility and ingenuity in unravelling the complexities of these reactions. The School of Physical Chemistry which he created at Aberdeen combined in a characteristic manner the experimental with the theoretical. Birmingham is to be congratulated in its choice.

Genetics at Birmingham : Dr. K. Mather

Dr. Kenneth Mather, who has been appointed to the chair of genetics now established in the University of Birmingham, is known for his, in some respects, revolutionary outlook on this subject. Dr. Mather derives this outlook from a fusion of several of the main streams of thought in biology. He went from Manchester in 1931 to work at the John Innes Horticultural Institution, where he obtained a thorough grasp of the chromosome theory of heredity as it was being developed there at the time. In 1933 he went for a year to Sweden, where he gained a great deal from studying the methods of plant breeding used at Svalöv and by that notable sugar beet breeder, Dr. J. M. Rasmusson. In 1934 he took a post with Prof. R. A. Fisher, under whom he became familiar both with the breeding of mice and the still rapidly developing technique of statistical genetics, to which he began to make serious contributions. In 1937 he spent a year with Morgan and East in the United States. Finally, in 1938 he returned to take up the post of head of the Genetics Department at the John Innes Institution. There he has remained for ten years carrying out (with a success that has now been recognized) the very definite purpose and programme that he had in mind when he went there—that of combining biometry and genetics into a single efficient tool for the study of evolution, the practice of plant and animal improvement and the understanding of biology as a whole. During these years, however, Dr. Mather, like other workers in this field, has been painfully conscious of the widening gap between the advances of genetic research and the status of genetic teaching in the universities. In his new post he will have an opportunity of narrowing this gap and of rendering a great service to the University of Birmingham.

British Jute Trade Research Association

The British Jute Trade Research Association has acquired premises on the Dundee Industrial Estate to replace the temporary accommodation at present occupied in Bellfield Street, Dundee, following negotiations with the Scottish Industrial Estates, Ltd., and various Government committees. The new buildings will be utilized for future research and development in connexion with the activities of the Association, and it is hoped to be in occupation early in 1949. When completed, the Laboratory Section will cover an area of approximately 6,500 sq. ft., and will contain physical and chemical laboratories, photographic and physical dark rooms, a room where constant temperature and humidity can be maintained, machine rooms, library and administration. A separate Engineering Development Section will in the first instance cover an area of some 2,000 sq. ft., and the personnel in this Section will work in very close collaboration with the Laboratory scientific staff. The remaining space of 14,000 sq. ft. will be devoted to the Processing Section, in which will be installed a complete range of all jute processing, weaving and finishing machinery. The building will be the first industrial research laboratory of its kind to be set up in Scotland for co-operative research, and is supported by practically the whole of the jute interests. The importance of scientific research to the industry is being realized more and more, and the support for the project illustrates the desire of the industrialist to utilize every possible means to increase efficiency and quality of product.

Science and Technology in China

The Natural Science Society of China has recently inaugurated a new bulletin, *Science and Technology in China*, of which two numbers of the first volume have already appeared. It is very well printed and produced and contains many interesting articles. In the April issue, Dr. Mao I-Sheng writes on the present position and outlook of research in the engineering sciences in China ; Dr. Li Ching-Yuan on current mineral exploration in China ; and Dr. Jen Mei-O on the progress of land utilization surveys in the south-west part of the country. The work of the Scientific Office of the British Council in China is reviewed at some length, and the rest of the bulletin consists of research reports similar to the correspondence columns of *Nature*, together with abstracts of papers read at the February 1948 meeting of the Chinese Chemical Society at Nanking. While China has had for many years its chief scientific journal analogous to *Nature*, namely, *Ko-Hsueh*, this has always been and will continue to be published in the Chinese language. There has therefore been room for a periodical, perhaps of a smaller character but in the English language, and the new venture deserves every success. The chief editor is Dr. Wu Hsueh-Chou (director of the Chemical Institute of Academia Sinica), and inquiries and subscriptions should be addressed to him at that Institute, 320 Yoyang Road, Shanghai. Foreign subscribers may also communicate with Mr. S. H. Doo, 7137 Penns n a Avenue, Pittsburgh 8, Pa., U.S.A. The annual subscription is 2.00 American dollars per annum, or its equivalent.

Cambridge University Educational Film Council

THE Cambridge University Educational Film Council was formed in February 1947 "to promote the use of films in higher education and for the purpose of academic research". The ultimate aim of the Council is the establishment by the University of Cambridge of a Film Centre with adequate facilities for the production, projection and storage of educational films; meanwhile, it is collecting information about educational films and film strips already in existence, giving technical advice to university departments wanting to make or project films, encouraging professional film units to consult with university teachers on the films required and their economic distribution, and arranging for the exchange of films with academic bodies of all kinds in Great Britain and other countries. Membership is open to members of the University, and all Faculties and Departments at Cambridge are automatically members of the Council. The General Board of Faculties and the Cambridge University Press appoint representatives to its executive committee. A memorandum on the provision of cinematograph facilities at Cambridge has been submitted by the Council to the General Board. The Council has already produced for distribution within the University a list of sources from which films suitable for use in university education can be procured, and obtained particulars of films made in Cambridge; it has also set up a library of film catalogues from Great Britain and abroad, and collected information regarding the use of films in a number of university departments outside Cambridge. At the suggestion of the Council, a conference on the use of films in universities was convened by the British Film Institute and the Scientific Film Association in November 1947, and a Universities Film Council for the British Isles has been established.

Televizing the Museum

THE Cleveland Museum of Natural History has again shown commendable enterprise in extending its educational influence to a much larger public than habitual museum visitors (*The Explorer*: Bulletin of the Cleveland Museum of Natural History, **94**; 1948). Through the courtesy of the American broadcasting station, W.E.W.S., it is now presenting a monthly television programme called "Your Museum of Natural History". Two general programmes have already been televized, one dealing with the timely subject of the Navaho Indians and the other with the recent gift to the Museum of the works of John J. Audubon, including the famous early nineteenth-century English prints of Havell. There is also a regular weekly television programme built round the Museum's explorers clubs for children; subjects so far presented include the Apache Indians, fur-bearing mammals, care of pets, bird migration and signs of spring.

Maps of Svalbard

NORGES SVALBARD og Ishavs-undersökelser, now known as Norsk Polarinstitutt, has begun the issue of a detailed map of Svalbard in folded sheets, each covering about 1,300 kilometres. The scale is 1 to 100,000. The map is based on a network of trigonometrical points and constructed from aero-photograms taken by oblique photography. It is in black for moraines, glacier limits and lettering, blue for seas, streams, lakes and glacier contours, brown for form lines and contours, and green for glacier slopes. In addition to the old place names in their accepted Norwegian forms, a number of new names have been added. The first sheet (price 3 kroner) covers the little-known Sörkapp area as far north as Hornsund and is numbered C.13.

Canadian National Research Council Scholarships

SCHOLARSHIPS have been granted by the National Research Council of Canada to 169 graduates for postgraduate studies during the academic year 1948–49. There are twenty-five fellowships at 900 dollars, sixty-three studentships at 750 dollars, seventy-five bursaries at 450 dollars tenable at Canadian universities, and ten special scholarships ranging in value from 500 to 1,000 dollars awarded for study abroad. The nominal value of all scholarships for the year is 107,900 dollars. Thirty departments of science are represented in the applications approved this year. Chemistry in its several branches is represented by 65 and physics by 62. The remaining awards are widely distributed in the other sciences as follows: agricultural bacteriology, 1; anatomy, 3; applied mathematics, 1; biology, 2; communications engineering, 2; dental bacteriology, 1; entomology, 1; experimental medicine, 1; genetics, 1; geology, 6; mathematics, 4; mathematical statistics, 3; medical research, 1; metallurgy, 1; mineralogy, 2; physiology, 3; physical metallurgy, 1; plant pathology, 1; and zoology, 7.

Conference on Civil Engineering Problems in the Colonies

A CONFERENCE on Civil Engineering Problems will be held at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1, during July 19–23, at which a number of papers on subjects of importance in Colonial development will be read and discussed. Mr. A. Creech-Jones, Secretary of State for the Colonies, has consented to open the Conference on July 20, at 10.15 a.m. Among the topics to be discussed are: development planning with special reference to physical development, the East African groundnuts scheme, road improvement in Jamaica, railway gauge in tropical Africa, railways and roads in Malaya, problems of labour and material in West Africa, Colonial housing, and engineering aspects of tropical hygiene. The Conference is open to members of the Institution, to engineers and to other officers specially interested who are employed in the Colonial Service, and to other engineers who are otherwise engaged in civil engineering work in the Colonies. Application forms can be obtained from the secretary of the Institution of Civil Engineers.

Unione Matematica Italiana

THE third national congress of the Unione Matematica Italiana is to be held at Pisa during September 23–36. The congress will be devoted to a comprehensive review of the Italian contributions to mathematics during the last few years, and particularly in so far as they are linked up with the mathematical activities of other countries during the same period. In addition to papers on pure and applied mathematics, special sections will deal more particularly with analysis, geometrical mechanics, mathematical physics, actuarial mathematics and probability, geodesy, astronomical and astrophysics, mathematics applied to engineering, the history of mathe-

matics and didactics. The Unione Matematica Italiana cannot offer any financial assistance to visitors; but it is expected that expenses for the stay at Pisa will be low. All inquiries relating to the Congress should be sent to Prof. Luigi Berzolari, Università di Bologna, Bologna, president of the Unione Matematica Italiana, who is acting as secretary to the Congress.

British Thomson-Houston Summer School

THE British Thomson-Houston Co., Ltd., Rugby, is holding a summer school in electrical engineering during July 12–16. Sir Henry Tizard is to open the school, which will consist of lectures and discussions on such topics as electronic control of motors, magnetic sheet steel, examination of large forgings, high-power pulse generation, power system analysis, switchgear problems, betatron developments, electric discharge and fluorescent lamps, etc. Tours of the Company's works have also been arranged. The purpose of the school is to enable engineers in academic posts to obtain first-hand knowledge of the more important recent advances in electrical engineering; attendance is by invitation of the Company. Further particulars can be obtained from the Manager, Publicity Department, British Thomson-Houston Co., Ltd., Rugby.

Seventh International Congress of Food and Agricultural Industries

THE Seventh International Congress of Food and Agricultural Industries will meet in Paris during July 12–18 at the invitation of the French Government. Among the subjects for discussion are: the role of vitamins, hormones and trace-substances, ionic exchanges in sugar-refining, fermentation, homologization of malt, bread-making qualities of wheats, rational use of the combined harvester, improvements in the dairying and canning industries, advances in the feeding of livestock, digestibility of fats and oils, destruction of organic matter in waste waters, standardization of statistical methods, and technical instruction. Further details can be obtained from the Commission Internationale des Industries Agricoles, 18 Avenue de Villars, Paris.

University of London

THE following appointments in the University of London have been announced: Dr. G. C. McVittie, to the University chair of mathematics tenable at Queen Mary College as from October 1; since 1936 he has been reader in mathematics at King's College, but during the War was engaged on work at the Government Communications Headquarters. Dr. Sidney Smith, honorary professor of Near Eastern archæology at the Institute of Archæology, London, to the University chair of ancient Semitic languages and civilizations tenable at the School of Oriental and African Studies, as from October 1.

The title of professor emeritus of physics in the University has been conferred on Dr. Frank Horton, professor of physics at Royal Holloway College during 1914–46 and vice-chancellor of the University during 1939–45. The title of professor emeritus of chemistry in the University has been conferred on Prof. T. S. Moore, professor of chemistry at Royal Holloway College during 1914–46.

The degree of D.Sc. has been conferred on Dr. Adrien Albert (School of Pharmacy), Louis Essen and A. E. J. Went.

The Night Sky in July

NEW moon occurs on July 6d. 21h. 09m., U.T., and full moon on July 21d. 02h. 31m. The following conjunctions with the moon take place: July 5d. 16h., Venus 8° S.; July 5d. 18h., Mercury 8° S.; July 9d. 06h., Saturn 4° S.; July 11d. 16h., Mars 3° S.; July 18d. 01h., Jupiter 4° N. Mercury is too close to the sun in the early part of the month to be observed, but in the middle of the month the planet rises an hour before sunrise and attains its greatest westerly elongation on July 16. At the end of the month Mercury rises at 3h. 16m., about an hour before sunrise. Venus rises about a quarter of an hour before the sun on July 1 but can be observed later in the month, rising at 2h. 28m. and 1h. 41m. on July 15 and 31, respectively. The planet attains its greatest easterly elongation on July 16 and its greatest brilliancy on July 31, when its stellar magnitude is −4·2. Mars sets at 23h. 10m., 22h. 30m. and 21h. 45m. at the beginning, middle and end of the month, respectively, and can be seen for a short time in the western sky after sunset. Jupiter, in the constellation of Ophiuchus, is visible during the early part of the night, setting at 2h. 40m., 1h. 36m. and 0h. 33m. at the beginning, middle and end of the month, respectively. Owing to its large declination south, nearly 23°, the planet is not very well placed for observation in high northern latitudes. Saturn sets about an hour before Mars and cannot be observed very long after sunset; at the end of the month it sets a little more than half an hour after the sun. No occultations of stars brighter than magnitude 6 take place in July. The earth reaches aphelion on July 4, when its distance from the sun is 94,561,000 miles.

Announcements

DR. JULIAN HUXLEY has been elected *Correspondant* for the Section of Anatomy and Zoology of the Paris Academy of Sciences.

THE honorary degree of D.Sc. of the University of Oxford has been conferred on Dr. Isaiah Bowman, president of Johns Hopkins University, and president during 1931–34 of the International Geographical Union; and on Prof. Linus Pauling, professor of chemistry and director of the Gates and Crellin Chemical Laboratories, California Institute of Technology, who is now George Eastman visiting professor at Oxford.

MR. E. I. R. MACGREGOR has been appointed assistant civil air attaché at the British Embassy, Washington, in succession to Mr. N. Bicknell, who is entering the Foreign Service. Mr. MacGregor took first-class honours in physics at the Queen's University, Belfast, and after a short period on television research with Electric and Musical Industries, Ltd., he entered the R.A.F. Education Service (1936). During 1941–46 he served on the British Air Commission and R.A.F. Delegation at Washington.

A NEW exhibit of Protozoa in the Zoological Department of the British Museum (Natural History) has been opened to the public. It adjoins the Coral Gallery, which was reopened a few weeks ago. Owing to the minute size of these organisms, all but a few of the larger marine forms are displayed either by means of enlarged glass models or by tinted line drawings.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Carbon Monoxide Affinity of Chlorocruorin and Hæmoglobin

CHLOROCRUORIN, the green-red respiratory blood pigment of certain marine annelid worms, is the only known substance built on the same plan as hæmoglobin. Like most kinds of hæmoglobin, chlorocruorin has a higher affinity for carbon monoxide than for oxygen[1]. This property, valueless to animals, is utilized in experimental work to eliminate the possible respiratory activity of these pigments and so to test their functional significance[2,3]. The relative affinity of chlorocruorin (*Ch*), or of hæmoglobin, for the two gases in the reversible reaction

$$\mathrm{O}\ Ch + \mathrm{CO} \rightleftharpoons \mathrm{CO}Ch + \mathrm{O}_2$$

is given by the equilibrium constant K in the equation

$$K = [\mathrm{CO}Ch]/[\mathrm{O}\ Ch] \times p\,\mathrm{O}_2/p\,\mathrm{CO},$$

from which it is seen that when the pigment is 50 per cent in the carboxy state and 50 per cent in the oxy state, K becomes the ratio of oxygen to carbon monoxide.

Krogh[4] was the first to show that different kinds of animals have different values of K. For the hæmoglobin of human blood, K has been found to be 235 or 246 (Douglas, Haldane and Haldane)[5], 240 (Killick)[6] or 490 (Anson *et al.*)[7]. The values for certain other hæmoglobins have been found to be as high as this or higher. For yet other hæmoglobins the values of K are low, that of horse muscle hæmoglobin (myoglobin)[8,9] being 14–51, of the hæmoglobin of leguminous root nodules[10] 37, and of the larva of the horse bot-fly (*Gastrophilus*)[11] 0·67. With these very considerable known differences in the relative affinity of hæmoglobins for carbon monoxide and oxygen, it was of interest to find the values of the equilibrium constant for several invertebrate hæmoglobins and for a chlorocruorin.

The blood of each kind of animal was diluted in $M/20$ phosphate buffer at pH 7·3 and then centrifuged and filtered to give a limpid solution. Some of this was put into a modified Thunberg tube with a 2 cm. optical cell, and the concentration was adjusted to give an optical density ($\log_{10} I_0/I$) of about 1·5 at the α-band, measured with a Hilger – Nutting visual spectrophotometer. After equilibration at 20° C., with air in the case of hæmoglobin, or oxygen for chlorocruorin (which cannot be saturated with oxygen at atmospheric partial pressure[11]), the densities were determined at wave-lengths 561 and 578 mμ for hæmoglobin, or 590 and 606 mμ for chlorocruorin. Previous plotting of the absorption curves of the oxy and carboxy compounds had shown that the two wave-lengths mentioned are those at which the light absorption differs most. The Thunberg tube was then evacuated, filled with an appropriate mixture of oxygen and carbon monoxide to obtain about a half-and-half mixture of the two compounds of the pigment, and the solution equilibrated with the gas by rotation for half an hour in a water thermostat at 20° C. in dim light, after which the changed densities were determined at the same two wave-lengths. (Although both carboxy compounds are dissociated by light[12,1], there was no progressive change in the spectrophotometer readings, even when the solution was left exposed to the lamp for a quarter of an hour; doubtless measurable changes only occur in thin layers.) The third step was to evacuate the tube anew, fill it with pure carbon monoxide, re-equilibrate and again measure the two densities. From the six density measurements the relative concentrations of the oxy and carboxy compounds in the solution in equilibrium with the gas mixture can be calculated by a formula given by Keilin and Wang[11], and from this the value of K in the equation above is directly deducible.

The following are the values of K which were obtained, in decreasing order of magnitude, the first being that of chlorocruorin, the remainder all of blood hæmoglobins: *Branchiomma vesiculosum* (Montagu), 570; *Chironomus dorsalis* Mg., 400; horse, 280; man, 230; *Arenicola marina* L., 150; *Tubifex* sp., 40; *Planorbis corneus* L., 40; rabbit, 40. From five to eleven determinations were made for each of the different animal forms. The values of K obtained for each of them varied considerably, and as there were not enough values to give standard errors, the means have been rounded to the nearest 10. There are several surprises in the results. The values differ greatly. The figure for man is virtually the same as those previously found by Douglas, Haldane and Haldane[5], and by Killick[6], which are given above. Anson *et al.*[7], who obtained a much higher value for man, agree with me in placing the horse a little above man and the rabbit much lower. The highest hæmoglobin value is that of the blood-worm, the larva of a midge, *Chironomus*. But chlorocruorin has a far higher value than any hæmoglobin. The lowest values which I found, namely, those of the oligochæte worm *Tubifex*, of the pond snail *Planorbis* and of the rabbit, are about the same as for the muscle hæmoglobin of the horse and the hæmoglobin in the root nodules of leguminous plants.

It is not possible at present to correlate the diverse values of K with other properties of these hæm pigments. *Chironomus*, with the highest value of K for any hæmoglobin, has also the highest oxygen affinity of a blood hæmoglobin[13], but chlorocruorin, with a still higher K, has an oxygen affinity much lower than any hæmoglobin[14]. The hæmoglobin in the muscle of the horse has a higher oxygen affinity than that of the blood, but a much lower K. The highest value of K in a hæmoglobin (*Chironomus*) and the lowest value (*Gastrophilus*) are both in the Insecta, in which class hæmoglobin is extremely rare. Keilin and Wang[11] have shown that there is no relation between K and span (difference between wave-lengths of oxy and carboxy α-bands) as was once thought. It is for future biochemical and physicochemical research to find the meaning of the very diverse values of K.

My sincere thanks are due to Prof. D. Keilin and Dr. E. F. Hartree for advice and help.

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May 14.

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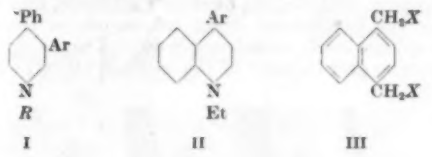
Synthetic Analgesics

ATTEMPTS to prepare new analgesics have, for many years, been based almost exclusively on the morphine molecule, the peripheral groups of which may be modified considerably with relatively little effect on the biological activity. The synthetic drug 'Pethidine' (ethyl 4-phenyl-1-methylpiperidine-4-carboxylate) has several structural features in common with morphine, and there is a considerable body of evidence which relates analgesics of the piperidine type to the morphine model[1-4]. The recently discovered 'Amidone' (*dl*-2-dimethylamino-4 : 4-diphenylheptan-5-one) is also a potent analgesic. We have examined three types of compound for analgesic, antispasmodic and local anæsthetic action. Although none of these compounds is closely related to morphine, several have an analgesic potency equivalent to or approaching that of 'Pethidine'.



I II III

The synthesis of compounds of type I has already been reported[5]. Compounds of type II (in which Ar = Ph, or *p*-MeO.C_6H_4—) have been prepared by hydrogenation of the oximes of ethyl β-(2-keto*cyclo*hexyl)-β-arylpropionates, and the *p*-methoxy compound has also been demethylated to the corresponding *p*-hydroxy derivative[6]. The preparation of our compounds of type III has not previously been described. 1 : 4-*Bisdiethylaminomethylnaphthalene hydrochloride* (X = —NEt) was obtained as colourless needles, m.p. 229–230°, by condensing 1 : 4-bischloromethylnaphthalene[7] with diethylamine. (Found : C, 63·3 ; H, 8·4 ; N, 7·0. $C_{16}H_{22}N_2Cl_2.\frac{1}{2}H_2O$ requires C, 63·1 ; H, 8·7 ; N, 7·3 per cent. The *picrate* formed yellow needles, m.p. 203–204°. Found : C, 50·65 ; H, 4·6 ; N, 14·9. $C_{32}H_{28}O_{14}N_8$ requires C, 50·8 ; H, 4·8 ; N, 14·8 per cent.) 1 : 4-*Bisisothiocarbamidomethylnaphthalene hydrochloride* (X = —SC(=NH)NH_2) was obtained as colourless plates, m.p. 270–272°, from the bischloromethyl compound and thiourea. (Found : C, 44·8 ; H, 4·6 ; N, 14·5. $C_{14}H_{18}N_4Cl_2S_2$ requires C, 44·6 ; H, 4·8 ; N, 14·8 per cent. The *picrate* formed yellow needles, m.p. 219–220°. Found : C, 41·2 ; H, 3·0. $C_{26}H_{22}O_{14}N_{10}S_2$ requires C, 41·0 ; H, 2·9 per cent.)

The L.D.$_{50}$ in mgm./kgm. was determined by intraperitoneal injection in white mice. Of the *N*-alkyl-3 : 4-diarylpiperidines (type I), increase in the length of the alkyl chain decreased toxicity from 90 mgm./kgm. for 3 : 4-diphenyl-1-methylpiperidine to 250 mgm./kgm. for 3 : 4-diphenyl-1-*n*-butylpiperidine. In group II, 1-ethyl-4-(*p*-hydroxyphenyl)decahydroquinoline (120 mgm./kgm.) was less toxic than the unsubstituted 4-phenyl compound (80 mgm./kgm.). In group III, the thiourea derivative (61 mgm./kgm.) was much more toxic than the diethylamino derivative (370 mgm./kgm.). The Straub tail phenomenon was present in greater or less degree in mice poisoned with various members of each group. Compounds of types I and II mainly produced motor excitement (as does 'Pethidine') ; group III was depressant.

TOXICITY AND ANALGESIC ACTIVITY

Name	Relative analgesic potency (mice)	L.D.$_{50}$ (mgm./kgm.) intraperitoneal injection, mice
3 : 4-Diphenyl-1-methylpiperidine HCl	stimulant	90
3 : 4-Diphenyl-1-ethylpiperidine HCl (*A* isomer)	0·6	100
3 : 4-Diphenyl-1-ethylpiperidine HCl (*B* isomer)	0	130
3 : 4-Diphenyl-1-*n*-butylpiperidine HCl	0·6	250
4-Phenyl-3(*p*-methoxyphenyl)-1-ethylpiperidine HCl	0·4	150
4-Phenyl-1-ethyldecahydroquinoline HCl	0·6	81
4-(*p*-Methoxyphenyl)-1-ethyl-decahydroquinoline HCl	0·7	100
4-(*p*-Hydroxyphenyl)-1-ethyl-decahydroquinoline HBr	0	120
1 : 4-Bisdiethylaminomethyl-naphthalene HCl	1·0	370
1 : 4-Bis*iso*thiocarbamidomethyl-naphthalene HCl	1·0	61
'Pethidine'	1·0	150

Drugs in group I were irritant when placed in the conjunctival sac of rabbits, and neither group I nor group III showed any evidence of local anæsthetic properties. Group II drugs were less irritant than group I and had some effect as anæsthetics. The most powerful, 1-ethyl-4-(*p*-methoxyphenyl) decahydroquinoline, had a potency of 10 per cent of cocaine hydrochloride. The compounds were tested for antispasmodic activity against barium chloride (5 mgm.), histamine base (1 μgm.), acetylcholine (1 μgm.) in a 75 ml. bath. None of the compounds was highly specific, but all had some antispasmodic activity. Group I compounds were most active, 3 : 4-diphenyl-1-ethylpiperidine having 1/33 the activity of benadryl against spasm induced by histamine ; against acetylcholine, 1/250 the activity of atropine sulphate ; against barium, 1/6 the activity of 'Pavatrine'. Group II and group III were of a similar order of potency against barium-induced spasm, but much less active against histamine and acetylcholine. The analgesic potency was estimated according to the method of Davies *et al.*[8], except that mice were used instead of rats. Group III drugs were found to be equal in potency to 'Pethidine'. Groups I and II showed lesser and varying degrees of potency, and 3 : 4-diphenyl-1-methylpiperidine is a stimulant. The considerable analgesic activity of 1 : 4-bisdiethylaminomethylnaphthalene is of interest, as this is a new class of compound to exhibit pronounced activity.

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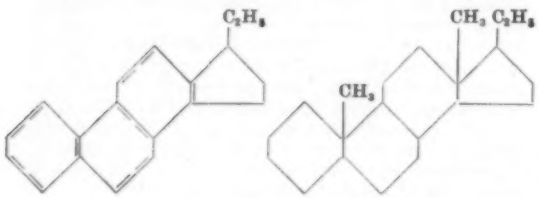
Constitution of Conessine

PREVIOUS work has shown that the alkaloid, conessine, is a ditertiary base, $C_{24}H_{40}N_2$, containing three N-methyl groups and one ethylenic linkage, and our work now establishes a relationship with the growing class of steroid bases. The absence of oxygen is noteworthy; this is uncommon in the alkaloids, and the natural occurrence of an oxygen-free steroid derivative has not been reported previously.

The first indication of the structure came from an examination of the selenium dehydrogenation products of the hydrocarbon mixture, $C_{21}H_{30}$, obtained by pyrolysis of conessine dihydriodide[1]. Careful fractionation of the products yielded a crystalline hydrocarbon, $C_{19}H_{18}$, m.p. 78–79°, which showed many similarities with synthetic[2] 3′-ethylcyclopentenophenanthrene (I), m.p. 84·5–85·5°.

Although the hydrocarbons and their derivatives with nitrohydrocarbons gave no depression in melting point on admixture, it was not possible to raise the melting point of the hydrocarbon obtained from conessine, even after recovery from the nitrohydrocarbon complexes; and, as some discrepancies were observed on comparison of the ultra-violet absorption spectra and X-ray photographs of the two hydrocarbons, the identity was not convincingly established.

By subjecting conessine to successive degradations by the Hofmann and Emde processes, Späth and Hromatka[3] obtained a hydrocarbon, $C_{21}H_{32}$, which gave a hexahydroderivative, $C_{21}H_{38}$, m.p. 56–58°. In our hands this reduction has yielded approximately equal amounts of two isomeric hydrocarbons, $C_{21}H_{38}$, m.p. 56–58° and 83–84° respectively. The former is presumably identical with the hydrocarbon obtained by Späth and Hromatka, and the isomer, m.p. 83–84°, is identical, chemically and physically, with *allo*pregnane (II), prepared from progesterone by described methods[4].



I II

The carbon atoms of conessine are therefore accounted for by the *allo*pregnane structure (II) and the three N-methyl groups, but the positions of the ethylenic linkage and the points of attachment of the basic centres are still uncertain. Structural investigations on conessine and its relatives are being developed in several directions, and a full account will be published elsewhere.

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[1] Siddiqui and Sharman, *Proc. Ind. Acad. Sci.*, **6** A, 191 (1937).
[2] Riegel, Gold and Kubico, *J. Amer. Chem. Soc.*, **65**, 1772 (1943).
[3] *Ber.*, **63**, 126 (1930).
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Quantitative Electron-Density Contour Delineation in the Electronic Fourier Synthesizer for Crystal Structure Analysis

THE electronic Fourier synthesizer for crystal structure analysis reported earlier from this laboratory[1] has been modified so that contour lines of projected electron densities from one cell on any desired lattice plane can be accurately delineated.

It was originally intended that a pattern corresponding to a Bragg photographic synthesis be presented on a cathode ray tube screen; and the remark was made in the early report that such a presentation should not be considered as a replacement for accurately calculated contour maps, due to obvious limitations on linearity and range of screen response. This inexactness is removed by triggering coincidence circuits, set at predetermined voltage levels, directly from the voltage signal formerly applied for intensity modulation to the cathode ray tube grid. The circuits produce 1 microsec. pips each time the synthesized signal crosses one of the preset voltage levels, and these are applied to the cathode ray tube grid in place of the entire synthesis signal.

Fig. 1

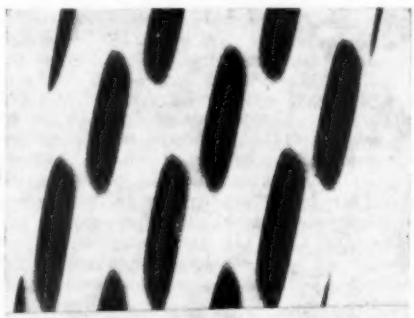

Fig. 2

The contouring technique has been applied to the model synthesizer which was demonstrated at the Annapolis meeting of the Crystallographic Society of America on March 20, 1947[2]. Fig. 1 shows an intensity-modulated pattern corresponding to the superposition of (2, 0, 3) and (1, 0, $\bar{3}$) fringes, for a *c*-axis projection of a monoclinic cell with $a : c \approx 1{\cdot}0 : 1{\cdot}1$ and $\beta \approx 81°$. Fig. 2 shows a four-line contour map of the same projection. (It may be recalled that the axial ratio and angle of a projection can be adjusted at will on the synthesizer[1].) These photographs are obtained directly from the presentation tube.

The apparent difference in contours of some peaks in Fig. 2 is due to non-linearity of sweep in the model

synthesizer. In the large synthesizer for a 20 by ± 20 matrix of terms, construction of which is in progress, these and other imperfections are removed. Co-ordinate lines (of controllable intensity) are also available in the large device, so that accurate location of peaks is possible. The size and conditions of operation of the final synthesizer will be such that as many contour lines as are desired can be accommodated. The zero-level of electron density can be set in through adjustment of the overall D.C.-level of the synthesized signal.

Development of the electronic Fourier synthesizer is supported by the Office of Naval Research, Navy Department, Washington, D.C., under Contract No. N7onr-377.

The simple contouring procedure grew out of conversations with Prof. A. L. Patterson, of Bryn Mawr College. The long-standing interest, support and valuable suggestions of Prof. Patterson in this entire development are much appreciated.

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[1] Pepinsky, R., *J. Appl. Phys.*, **18**, 601 (1947).
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Low-Angle X-Ray Diffraction Pattern of Collagen

IT is generally accepted that the low-angle X-ray diffraction pattern of collagen is unidimensional in the direction of the fibre axis with a fundamental period of 640 A.[1]. Variations in the water content of the fibre, effected by a control of the ambient relative humidity during the X-ray exposure, alter this spacing from 628 A. at 2 per cent relative humidity to 672 A. at 100 per cent relative humidity. This continuous increase in spacing is accompanied by drastic fluctuations in the relative intensities of the various orders.

If the uptake of water by the collagen produced a uniform extension of the molecule, no change in the intensities of the orders in the diffraction pattern would be observed. The intensity variations of the reflexions which do occur can only be explained by a non-uniform alteration in the electron density. As the most significant intensity changes occur in the low-order reflexions, the increase in spacing brought about by water absorption could be interpreted as water entering between the collagen molecules, thus influencing molecular packing. Any non-uniform change in the molecular configuration, such as an alteration in the spacing of certain atomic groups, would occur over relatively short distance in the molecule and would affect the intensities of the high-order reflexions accordingly. Perutz[2] has observed similar effects in the variations in the intensities of reflexions in the X-ray diffraction patterns of crystalline proteins.

The source of collagen used for this X-ray diffraction study was kangaroo tail tendon, since a high degree of orientation is present in the natural state of the material. By staining all the samples with an unbuffered 1 per cent solution of phosphotungstic acid, the intensity of all the reflexions was increased (thus reducing the required exposure time), with no apparent alteration of the diffraction pattern.

INTENSITY OF ORDERS

Relative humidity	100%	100%	90%	55%	30%	20%
Order number						
2	2	1	6	13	7	9
3	21	24	21	16	13	17
4	5	6	13	12	9	14
5	58	53	36	13	14	12
6	14	13	28	26	24	39
7	30	31	22	12	12	13
8	14	18	18	12	10	12
9	29	29	27	18	13	14
10	5	4	4	2	2	1
11	8	9	9	6	3	4
12	8	8	4	3	3	3
13	5	4	5	5	3	2
14	2	3		2		2
15	5	6		3		2
16	2	2		2		1
17	4	4		4		2
18	4	4		3		
19	4	5				2
20	4	5				
21	3	1				
22	3	3				
23	1	1				
24	2	1				
25	2	3				
26	2	3				
27	2					
Fundamental spacing in A.	672	666	655	646	636	630

The accompanying table indicates the humidities at which the diffraction patterns were photographed, the corresponding fundamental spacings, and the intensities of the various orders as measured by densitometric methods. Accurate comparison of these films is not possible because of variations in sample thickness and in film development. Recently, a second series of diffraction patterns has been photographed in which the same sample was used throughout, and all films were processed simultaneously. This procedure permits the desired accurate comparison of intensities. Further experiments are now in progress.

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[1] Bear, R. S., *J. Amer. Chem. Soc.*, **66**, 1297 (1944).
[2] Boyes-Watson, J., Davidson, E., and Perutz, M. F., *Proc. Roy. Soc.*, A, **191**, 83 (1947).

X-Rays and the Eigen-Vibrations of Crystal Structures

IN evaluating the effect of the atomic movements in a crystal on the propagation of a beam of X-rays through it, such of these movements as may be identified with the elastic modes of vibration of the solid may be taken up first for consideration. Each of these modes presents a distinctive pattern of nodal surfaces, the frequency of the oscillation being the same everywhere and the phase being opposite in every pair of adjacent cells in the pattern. The configuration of the nodal surfaces in any given mode is determined by various *macroscopic* factors, namely, the form of the crystal, the external boundary conditions and the elastic anisotropy, besides being dependent on the frequency of the mode. Hence, it would bear no particular relation to the atomic architecture of the crystal and would also be different for each of the numerous possible modes. These circumstances have important consequences in relation to the optical aspects of the problem. Each atom in the track of the X-ray beam may be con-

sidered as a source of secondary radiations of frequencies ν, $\nu + \nu^*$ and $\nu - \nu^*$, ν being the frequency of the X-radiation and ν^* that of the elastic vibration under consideration, and their effects have to be summed up over the illuminated volume. Since the amplitudes and phases of the radiations of modified frequency depend on the amplitudes and phases of the atomic movements, they would vary from atom to atom in a manner determined by the configuration of the nodal pattern, and hence would be different for each different ν^* and in no case would be definitely correlated with the internal architecture of the crystal. It follows that these scattered radiations cannot possibly give rise to any geometric diffraction pattern exhibiting an observable relationship to the structure of the crystal.

It remains to consider the possible vibrations in the solid which cannot be described as elastic modes, but which, on the other hand, are specifically related to the structure of the crystal and may therefore be designated as its eigen-vibrations. That such vibrations exist is proved by spectroscopic investigations, and their number and nature have been investigated by me[1] with results which have found experimental confirmation in various cases[2]. Since these eigen-vibrations are specifically related to the structure of the crystal, the secondary radiations of modified frequency resulting therefrom should be capable of giving rise to geometric diffraction patterns having a recognizable relationship to the internal architecture of the crystal. Theoretical considerations thus lead us to recognize the fundamental connexion between the eigen-vibrations of crystal structures and the dynamic X-ray reflexions exhibited by them. The existence of such a relationship and the possibility of the eigen-vibrations being excited even in the absence of thermal agitation first become apparent from the experimental facts discovered in the case of diamond by the present writer and Dr. P. Nilakantan[3].

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[1] *Proc. Ind. Acad. Sci.*, A, **18**, 237 (1943).
[2] *Proc. Ind. Acad. Sci.*, A, **26**, 339 (1947).
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Observations of Scatter Clouds

The observations made recently by P. Millman and his colleagues in Canada[1] are of particular interest to me. I have made many observations of these scatter clouds on waves of about 8 or 9 Mc./s. Thousands of photographs have been obtained, and an explanation of the effect of the clouds upon long-distance transmission has been given[2].

Although there is strong evidence that ultra-short-wave radar transmission is connected with meteors, the results of Millman and his colleagues show very clearly that scatter clouds are not only produced by

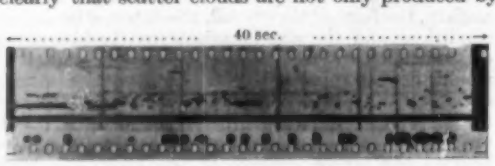

Fig. 1. G.M.T. 0130–0200, Nov. 15, 1937. Ongar, GOX, 32·35 M.

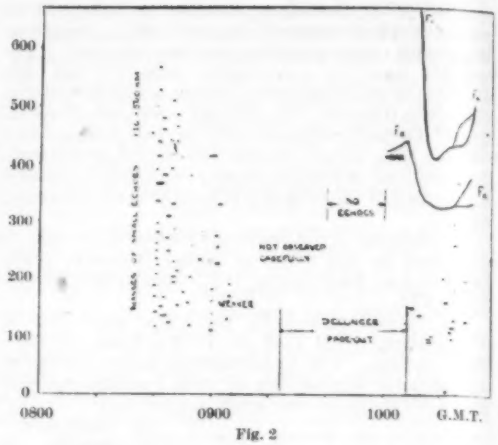

Fig. 2

meteors. I have shown that there is a large increase in these scatter clouds before a Dellinger fade (see Figs. 1 and 2). In Fig. 1 we see a number of scatter clouds which are not associated with visible meteors. The visible meteors are shown by marks at the edge of the film. In Fig. 2 we see a number of scatter clouds which occurred just before a Dellinger fade.

The mechanism I conceive of the production of scatter clouds in Dellinger fade conditions is as follows. There is a disturbed condition of the sun before, during and after Dellinger fades, with a large amount of ultra-violet radiation from it. This will produce photo-ionization in the particles of cosmic dust suspended at about 100 km. height. Before a Dellinger fade, such particles will produce showers of photo-electrons, and these will produce localized scatter clouds.

There are four main effects observed by Millman and his colleagues, and they can all be explained by the theory of the evaporation of meteors[3], the conditions obtaining during Dellinger fades and the physics of scatter clouds. They are:

(1) The absence of correlation of scatter clouds with meteors. They can equally well be associated with Dellinger fades.

(2) The presence of two types of scatter cloud in and above the *E* layer. This implies that there must be two different types of particle. These are the evaporated meteors and the unevaporated meteors. Meteor effects are exaggerated on high frequencies.

(3) The inadequacy of the explanation of height constancy obtained geometrically when the line from the transmitter cuts the meteor orbit at right-angles. The height constancy is a definite consequence of my theory of scatter clouds, and is produced by the range of penetration of the molecules from the particles evaporated. In the Dellinger fade theory it depends upon the range of the photo-electrons.

(4) The effect of wave-length. The wave-length effect can best be understood by referring to the mathematical form of the intensity of the waves scattered from a cloud. This is:

$$\delta\nu^2\,(\lambda/a)^4 \exp\{-f(h)\}$$

where ν is the critical frequency corresponding to the density of the cloud, a is the radius of the cloud, and $f(h)$ is a function of the height of the cloud above the earth.

This has three factors, which show that the biggest effect is produced by a large number of particles, that the wave-length λ reduces the effect at a given height in proportion to λ^4, and that there is an attenuation factor which is dominant. This attenuation factor has much more effect than the λ factor, and we get observations when the attenuation is small and the λ^4 factor does not matter so much.

Observations show that the only wave-lengths on which scatter clouds are wholly associated with meteors, and not with Dellinger fades, are the short ones. On all others they may equally well be associated with either. A comparison between the results of long-wave and short-wave experiments is interesting.

My picture is this: Meteor clouds and meteors penetrate rather deeply into the atmosphere and can only be observed when the attenuation factor is small, that is, when sufficiently high frequencies are used. The result is that sufficiently short radio waves select the meteor-produced clouds. Those produced at a constant height, as in Dellinger fade effects, are not selected, and require long waves to disclose them.

Fig. 14 in my paper referred to earlier[3] shows that the field scattered from a cloud is proportional to λ^4. This is a complete experimental confirmation of the theory of scatter clouds.

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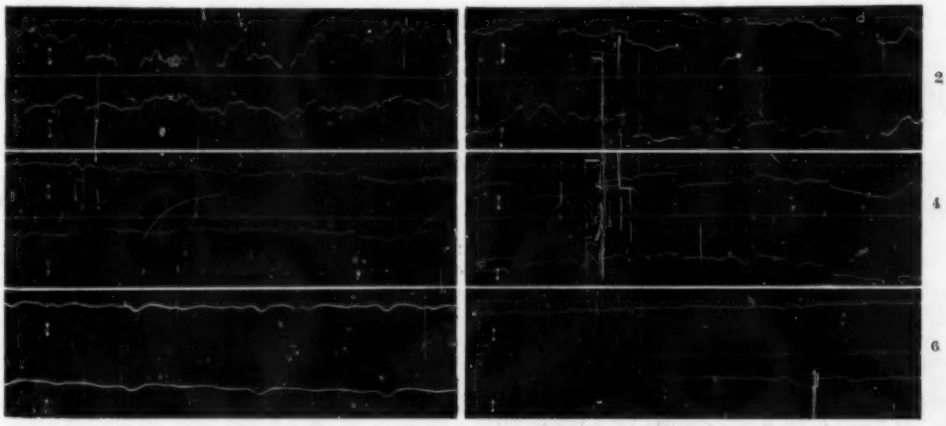
[1] *Nature*, **161**, 278 (1948).
[2] *J. Inst. Elect. Eng.*, **86**, No. 522, 548 (June 1940).
[3] *Nature*, **160**, 91 (1947).

Eye Movements During Monocular Fixation

A METHOD of recording small eye movements during monocular fixation has been described by one of us[1], in which a beam of ultra-violet radiation (λ = 3650 A.) is incident on the cornea in such a direction that the fraction of the light transmitted through the cornea falls on the subject's blind spot when some test object is fixated by the illuminated eye; the subject is then, in effect, only aware of the fixation target. Part of the radiation, however, is reflected at the cornea; this reflected beam strikes a half-aluminized mirror and is there divided so that one part falls on a vertical straight edge and the other on a horizontal one. In each case, more or less of the radiation passes the straight edge as the eye moves, the fraction passed being focused on to an electron multiplier photocell. The output of each multiplier is amplified and fed to a cathode ray oscillograph, the time base of which is suppressed. The two oscillograph beams are in this way arranged to give vertical traces only, which are photographed simultaneously on a continuously moving film travelling in the horizontal direction. The eye movements can then be deduced from the two records on the film. The system is sufficiently sensitive to detect eye movements of 1 minute of arc; deflexions due to noise from the multipliers do not, in general, correspond to more than half a minute of arc.

To reduce head movements, the subject is placed in the prone position with the head resting on a firm foundation and partially supported in a sling. He also bites on a dental impression mouthpiece suspended above him from an adjustable mounting. Slight head movements, however, persist; their effect on the corneal reflex, apart from compensating eye movements, was first found by recording the reflexion from an artificial cornea supported on a spectacle frame just above the live cornea. Afterwards, a more rigid attachment of the artificial cornea to the skull was obtained by mounting it on an aluminium strip, the other end of which was fixed to a dental regulation band clamped round one of the front teeth of the upper jaw. This method, however, presents difficulties in the case of observers with closely set teeth.

Head movement records for W. D. W. are shown in Fig. 1, as obtained by the tooth attachment method. The movements are seen to be periodic and are evidently related to the beating of the heart. The longitudinal movements are appreciably greater than the sideways displacement; but, even so, the greatest movement shown in the record corresponds to a displacement of the head of only 0·01 mm. Subject M. P. L. was unable to use the tooth attachment, but her steadiest eye movement records show



1. HEAD MOVEMENTS OF W. D. W. 2. HEAD MOVEMENTS OF M. P. L. (DERIVED). 3 and 5. EYE MOVEMENTS OF W. D. W. FIXATION TARGET, BRIGHT SPOT ANGULAR DIAMETER 3 MINUTES. 4 and 6. EYE MOVEMENTS M. P. L. FIXATION TARGET, BRIGHT CROSS, ANGULAR WIDTH ARM 1 MINUTE, ANGULAR LENGTH ARM 20 MINUTES. TIME MARKED BY DOTS, 50 PER SECOND. AMPLITUDE SHOWN AT SIDE: HEIGHT OF ARROWED LINE REPRESENTS 10 MINUTES OF ARC. UPPER RECORD GIVES EYE MOVEMENTS IN VERTICAL PLANE, LOWER RECORD IN HORIZONTAL PLANE

a periodicity similar to that occurring in the head movement records of W. D. W. From a study of several of her steadiest records, it was thus possible to deduce her head movements indirectly, as shown in Fig. 2.

Records 3 and 4 show typical eye movements for each subject during monocular fixation, when the subject was at his steadiest. The main feature which distinguishes the eye movements from the head movements is the rapid flick lasting 0·02–0·03 sec. and indicating a momentary angular movement of the eye of amplitude ranging from about 3 to 14 minutes of arc, and an average frequency of about 2 per sec. for W. D. W. and 3 every 2 sec. for M. P. L.

Between these flicks most of the recorded movement could be attributed to head movements, although in the absence of simultaneous head and eye movement records this is not certain. After each flick, the records suggest that the eye may take up a slightly different fixation direction displaced some few minutes of arc from the previous direction. This effect might be due to slight irregularities building up on the corneal surface; however, after-image experiments, for example, observation of the after-image of a bright annulus during fixation of a point source of light, seem to confirm the first interpretation.

On the majority of occasions, however, it was impossible to obtain records as steady as those in Figs. 3 and 4, random eye movements of 10 or 20 minutes of arc commonly occurring, as shown in Figs. 5 and 6. The gap at *P* in record 5 is due to a blink and indicates obstruction at the centre of the cornea lasting for 0·2 sec., in general agreement with data presented recently by Lawson[2]; in this, as in most cases, little subsequent disturbance in fixation direction has been produced.

Tests made with various fixation targets showed no significant variation in fixation ability, relative to the day-to-day variation in ability to fixate on a given target. There is little evidence of any fine vibratory movements having a period of the order of 0·02 sec. as reported by Adler and Fliegelman[3] and discussed at length by Jones and Higgins[4] in connexion with the resolving power of the eye.

We wish to acknowledge with thanks the financial support of the Medical Research Council in this work, and also the help of Mr. J. Baird in connexion with the dental regulation band.

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[1] Lord, *Proc. Phys. Soc.* (in course of publication).
[2] Lawson, *Nature*, **161**, 154 (1948).
[3] Adler and Fliegelman, *Arch. Ophthalmol.*, **12**, 475 (1934).
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The Fundamental Colour Sensations

IF pressure, sufficient to be thoroughly uncomfortable, is maintained by the fingers on the eyeball, numerous violet dots will eventually appear in among the other entoptical phenomena. Each dot lasts a second or so. If the pressure is suddenly released, all the entoptical phenomena disappear except the violet dots, which are left for a few seconds against a dark background. They are fairly uniformly distributed over the field of view, and may number anything up to, say, 100. From the fact that all the violet dots are of exactly the same hue, saturation and intensity and of approximately the same size, one is probably justified in assuming that they are the fundamental violet sensation. By looking at a spectrum with the other eye (light-adapted) it is possible to match their hue against a spectral hue. They match 440·5 mμ, the standard deviation of each observation being ± 5 mμ and that of the mean being ± 0·5 mμ. They are considerably more saturated in colour than spectral violet. Their apparent angular diameters are of the order of 10′. From the tritanopic isocolour chart given by Pitt[1], which depends on a description by Kōnig of five pathological cases of tritanopia, one can deduce that the fundamental violet sensation is equivalent to the sensation produced by 435 mμ, except that it is more saturated. Considering the inadequacy of the data available to Pitt, the discrepancy between 440·5 mμ and 435 mμ is not significant.

Gentler pressure will, in suitable circumstances, produce a uniform green colour of low intensity throughout the field of view. If one continues with this pressure for a minute or so, a green patch of greater luminosity but of about the same saturation appears, usually in the temporal field. By suitable adjustment of the pressure, it may be made to grow into a broad elliptical halo surrounding the macula, which by comparison looks black. The horizontal axes of the halo are about 1·3 times the vertical, the inside horizontal axis subtending about 7° and the outside about 30°. Both measurements are very variable, and occasionally the hole in the centre of the halo is green and is surrounded by darkness. The halo is slightly more saturated than any spectral green and matches 555 mμ, the standard deviation of each observation being 3 mμ and that of the mean being 0·7 mμ. This does not agree with the value 505 mμ obtained from Pitt's colour triangle for the hue of the green fundamental sensation, nor is it sufficiently saturated. It seems, indeed, to be a most improbable value for a fundamental sensation on any trichromatic theory which disallows negative stimulation. As the halo gets fainter, it appears to become slightly bluer in the same way as spectral 555 mμ does, but it is doubtful whether it ever becomes as blue as 505 mμ. Hence, in terms of trichromatic theory, it is probably a mixture in fairly constant proportions of the red and the green fundamental sensations only.

Reddish spots can also be made to appear. They are apparently of two or more different kinds, the smallest being very much smaller than the violet dots. All types are so fleeting that it is difficult to match them against the spectrum, or even to see whether they are alike.

No colourless entoptical phenomena appear as a consequence of pressure. This result and the occurrence of the violet dots at approximately the position in the colour triangle predicted by Pitt are rather more readily explained on classical trichromatic theory than on Granit's[2] theory of dominators and modulators.

All the above results were obtained on one observer (male) with normal colour vision.

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[2] "Sensory Mechanisms of the Retina" (Oxford Univ. Press).

Basque Blood Groups

We have determined the full *ABO*, *Rh* and *MN* blood groups of 167 Basques. The persons examined were selected as being of unmixed Basque descent, mostly by the Rev. Prof. J. M. de Barandiaran. None of the persons examined was known to be a blood relation of any of the others. The accompanying tables give a summary of our results.

ABO Groups

Group	Number	Frequency observed	Frequency expected	Gene frequencies
O	85	0·5090	0·5071	A_1 0·2343
A_1	67	0·4012	0·4002	A_2 0·0248
A_2	6	0·0359	0·0359	*B* 0·0288
B	7	0·0419	0·0418	*O* 0·7121
A_1B	2	0·0120	0·0135	
A_2B	0	0·0000	0·0014	
	167	1·0000	0·9999	1·0000

MN Groups

Group	Number	Frequency observed	Frequency expected	Gene frequencies
M	55	0·3293	0·3068	*M* 0·5539
MN	75	0·4491	0·4942	
N	37	0·2216	0·1990	*N* 0·4461
	167	1·0000	1·0000	1·0000

Rh Groups

Reactions with antisera Anti-					*Rh* phenotype frequencies Commonest genotype in each phenotype	Number	Frequency observed	Frequency expected
C	*D*	*E*	*c*	*e*				
−	−	−	+	+	*cde/cde* (*rr*)	48	0·2874	0·3275
+	+	−	+	+	*CDe/cde* (R_1r)	79	0·4731	0·3904
+	+	−	−	+	*CDe/CDe* (R_1R_1)	13	0·0778	0·1246
−	+	+	+	+	*cDE/cde* (R_2r)	13	0·0778	0·0795
+	+	+	+	+	*CDe/cDE* (R_1R_2)	10	0·0599	0·0487
+	−	−	+	+	*Cde/cde* (*R′r*)	3	0·0180	0·0180
−	+	−	+	+	*cDe/cde* (R_2r)	1	0·0060	0·0064
−	+	+	+	−	*cDE/cDE* (R_2R_2)	0	0·0000	0·0047
+	−	−	−	+	*Cde/Cde* (*R′R′*)	0	0·0000	0·0002
						167	1·0000	1·0000

Frequencies of gene combinations

cde	(*r*)	0·5723
CDe	(R_1)	0·3376
cDE	(R_2)	0·0688
Cde	(*R′*)	0·0157
cDe	(R_0)	0·0056
cdE	(*R″*)	0·0000
		1·0000

The high frequency of *Rh*-negative (*D*-negative) persons (30·5 per cent) and of the *d* gene (58·8 per cent) are in agreement with the findings of Etcheverry[1] and support the views recently put forward by one of us[2] regarding the history of the *d* gene. The low frequency of *cDE* is another notable feature. The excess of *Dd* heterozygotes and the deficiency of *MN* heterozygotes are clearly due to unavoidable errors of sampling. For this and other reasons steps are being taken to examine more persons. The combined results and a full discussion of them will be published elsewhere.

We should like to thank Prof. de Barandiaran and the members of the Basque delegations in London, Paris and Bayonne for their highly efficient organisation which alone made the collection of the specimens possible. One of us (J. N. M. C.) is in receipt of a Government Grant for Scientific Investigation through the Royal Society, and a grant from the Slater Fund at St. George's Hospital Medical School.

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Evolution of Hydrogen from Ferrous Hydroxide

It is generally supposed that ferrous hydroxide in aqueous suspension can decompose, according to the equation

$$3Fe(OH)_2 = Fe_3O_4 + 2H_2O + H_2.$$

The experiments of Schikorr[1] suggest that this can occur, but only in presence of metallic iron or excess of ferrous salt in solution.

The matter is important in connexion with the attack of iron by pure oxygen-free water. Warner[2] showed that a reaction such as

$$Fe + 2H_2O = Fe(OH)_2 + H_2$$

is permissible on grounds of energy; it might, however, be precluded on grounds of geometry if a continuous film of ferrous hydroxide were built up, separating the iron from the water. Possibly this protection might fail if the hydroxide were converted to anhydrous magnetite (a denser substance, commonly produced in granular form).

Actually, Murata[3] found that oxygen-free water acting on iron powder evolved hydrogen for a month, yielding ferrous hydroxide crystals; but Thompson[4], also using iron powder, reported the formation of magnetite on the glass apparatus; Corey and Finnegan[5], starting from iron rods, obtained non-adherent magnetite. Gould[6], working in this laboratory, observed no granular magnetite when water at the boiling point acted on steel with exclusion of oxygen; hydrogen was evolved at first, but attack soon became negligible, evidently owing to the formation of a protective film. In other experiments, where oxygen was intentionally admitted, a mass of magnetite and rust was found adhering to the metal at a few points only; it was probably formed by secondary oxidation of the ferrous hydroxide, mainly at a distance from the metal; its removal revealed deep corrosion-grooving. There is no necessary inconsistency between these various results, but it is clearly important to decide under what conditions Schikorr's reaction can occur; hence some new experiments have been carried out.

Ferrous hydroxide, pure enough to be almost colourless, was precipitated by mixing ferrous chloride and potassium hydroxide solution in an atmosphere of hydrogen. These solutions were prepared by the electrolysis of a de-aerated potassium chloride solution between a platinum cathode and a pure iron anode; the design of the apparatus was such that premature mixing of anodic and cathodic products did not occur and that the two solutions could be mixed in any desired proportions. The de-aeration was carried out by boiling followed by the

passage of hydrogen through the solution. After precipitation, the ferrous hydroxide and supernatant liquid were left in a flask connected to a manometer, so that any evolution of hydrogen might be detected by a pressure increase. No hydrogen evolution was detected under these conditions, even with ferrous chloride in excess.

Further experiments were then performed, following more closely those of Schikorr[1]. Here the ferrous hydroxide was prepared by precipitation from a ferrous sulphate solution with sodium hydroxide. Under these conditions Schikorr reported evolution of hydrogen at room temperature, when ferrous sulphate was in excess, but not when alkali was in excess. However, in our experiments, no evolution of hydrogen was observed even when the reactants were heated to 100° C.

It was nevertheless found that hydrogen was evolved at room temperature, in the presence of excess ferrous sulphate, if certain additions were made to the solution before precipitation with alkali. These additions included platinum chloride, colloidal platinum, nickel sulphate, nickel powder and copper powder. A smaller evolution was also produced by the addition of sodium sulphide. It is as yet uncertain whether these metals themselves or their ions in solution are the true catalysts, and no views on the mechanism of the reaction are here offered.

No hydrogen has yet been obtained after the addition of manganese sulphate—a matter of obvious importance in connexion with steel.

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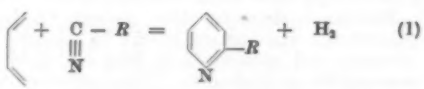
Reaction of Cyanogen and Related Compounds with Butadiene

Cyanogen and butadiene have been found to react at moderately high temperatures (400°–700° C.), forming as the main product 2-cyanopyridine. It has also been established that this behaviour of cyanogen may be generalized for the simple 1,3-dienes[1,2].

The present communication presents the results of some calculations and experiments with nitriles of the type *R*—CN, where *R* is H, CH_3, C_6H_5, as well as CN. In each case, the free-energy change for the reaction :



(1)

has been calculated over a range of temperatures in order to obtain information useful as a guide in the experimental investigation. These results are summarized in Table 1. The thermodynamic functions for 2-methylpyridine, 2-cyanopyridine and benzonitrile were calculated statistically, the vibrational frequencies of these compounds being assigned on a semi-empirical basis involving a consideration of the assignment for pyridine and benzene, and also the frequencies associated with the vibrations of the methyl and cyano groups. The functions for 2-phenylpyridine were estimated by a method of increments from the functions of 2-methylpyridine and benzene.

Table 1

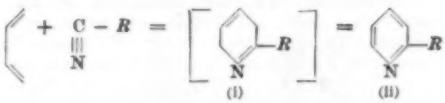
Reaction 1 with *R* as :	Product	ΔF (kcal.) for the reaction			
		T° K. 400	600	800	1000
H	Pyridine	−23·9	−20·9	−17·8	−14·7
CH_3	2-Methylpyridine	−18·9	−14·5	−11·1	−4·66
C_6H_5	2-Phenylpyridine	− 7·07	−5·37	−4·05	−2·05
CN	2-Cyanopyridine	−30·1	−27·2	−25·6	−20·6

It is seen that the calculated free-energy change is quite favourable over the temperature range in question in each case ; but since these results refer to equilibrium in ideal gaseous systems, a quantitative correlation with the experimental work has not been attempted. In Table 2 the data for three comparable vapour-phase experiments are given. The experiments were carried out at atmospheric pressure in an unpacked quartz reaction vessel, using continuous flow technique. The product in each case was identified by its known physical constants, and the melting point and analysis of the picrate. The yields are calculated on the amount of nitrile converted.

Table 2

Reaction 1 with *R* as :	Product	Temp. °C.	Contact time	Mol. ratio *R*CN/C_4H_6	Yield of product
H	Pyridine	595±5°	30 sec.	1·1/1·0	5–6 %
CH_3	2-Methylpyridine	599±5°	30 ,,	1·7/1·0	5–6 ,,
C_6H_5	2-Phenylpyridine	591±5°	31 ,,	1·7/1·0	12–16 ,,

These reactions may be explained as proceeding by a Diels – Alder mechanism in which the (—C≡N) has the role of the dienophilic component of the dienophile :



(i) (ii)

The intermediate (i) has not been observed among the products, and it would seem that it undergoes spontaneous dehydrogenation at these temperatures to form the thermodynamically more stable pyridinic product (ii).

A fuller account of this work is to be published elsewhere. The investigation is being continued.

We wish to thank Prof. C. K. Ingold and Dr. Albert Wasserman for helpful discussions, and Imperial Chemical Industries, Ltd., for some of the chemicals necessary for this investigation.

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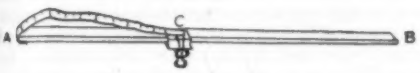
Rapid R_F Measurement in Chromatography

THE device described here has proved very useful for the rapid measurement of R_F values on paper partition chromatograms[1]. In the figure, *AB* is an aluminium strip 20 in. × ½ in. × ⅛ in., *AC* is a piece of white elastic 9 in. × ½ in. attached to the end *A* of the strip by sewing through a hole in the strip. The other end of the elastic *C* is attached to a small 'bulldog' clip. A scale (divided into 100 parts) is marked on the elastic. For use, the zero of the scale is placed at the origin line or spot and the 100 mark stretched out to coincide with the position



reached by the solvent front. The R_F values of the spots can then be read off directly on the scale. While α-amino-acids can be recognized simply from their relative positions on a chromatogram, the device allows a quick check on isolated or unknown spots or the spread of a spot. A smaller apparatus on the same expanding-scale principle can be used for measuring the *R* value[2] of substances on a column where the ratio, movement of band/movement of sample of liquid in unpacked part of the column above, is employed.

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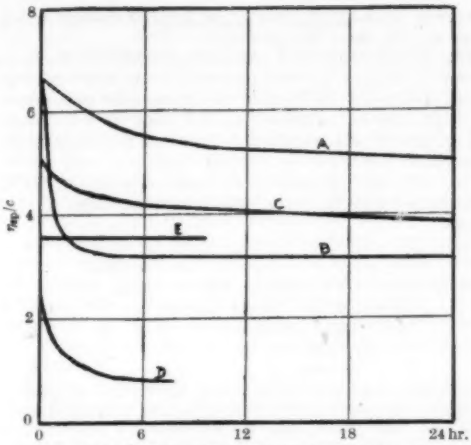
Degradation of a Vinylidene Chloride Copolymer in Solution

SOME observations have recently been made on the changes in viscosity of solutions of a copolymer containing approximately 85 per cent vinylidene chloride, 13 per cent vinyl chloride and 2 per cent acrylonitrile (by weight). The polymer was soluble in hot, but not in cold, tetrahydrofuran: once it had been dissolved by heating in the solvent at 60–65° C. for 2-3 min., the solution could be cooled to room temperature without gelling or precipitation.

Copolymer solutions of different concentrations, made up in redistilled tetrahydrofuran by heating as above, were aged in sealed glass tubes in contact with air for varying times at 50° C. and 75° C. Typical curves showing the changes in η_{sp}/c (where η_{sp} is specific viscosity and *c* is concentration in monomoles per litre) of the solutions with time are reproduced herewith (Curve *A*, 50° C., Curve *B*, 75° C.).

Investigation showed that the tetrahydrofuran used contained peroxides, and further work showed that: (*a*) a similar fall in η_{sp}/c was observed in cyclohexanone at 75° C., and in dioxane at 85° C., both in air (Curves *C* and *D*); (*b*) a slight reduction in η_{sp}/c took place in *peroxide-free* tetrahydrofuran at 75° C. in air; (*c*) little or no reduction in η_{sp}/c took place in *peroxide-free* tetrahydrofuran at 75° C. in nitrogen; (*d*) no reduction in η_{sp}/c took place in *o*-dichlorbenzene at 130° C. in air (Curve *E*).



AGEING OF VINYLIDENE CHLORIDE COPOLYMER SOLUTIONS

A. In tetrahydrofuran at 50° C.
B. ,, ,, ,, 75° C.
C. ,, cyclohexanone ,, 75° C.
D. ,, dioxane ,, 85° C.
E. ,, *o*-dichlorbenzene ,, 130° C.

These observations are consistent with the view that the viscosity decrease in these polymer solutions is due to a degradative attack on the long-chain molecules, not by oxygen directly, but by peroxides formed from the solvent and atmospheric oxygen. Tetrahydrofuran, cyclohexanone and dioxane are all known to peroxidize in the presence of oxygen (presumably with the formation of hydroperoxides at the carbon atoms adjacent to the ether oxygen or carbonyl group), while *o*-dichlorbenzene would not be subject to such an attack. Degradation of this type has previously been found to occur in the presence of oxygen[1-3], but the role of the solvent does not appear to have been appreciated.

That the changes in viscosity are most likely to be caused by polymer chain scission, rather than by any physical changes in the solution (breakdown of polymer aggregates, solvation[4], etc.) is also indicated by the fact that copolymer from a solution in tetrahydrofuran aged at 75° C. for 5 hr. (isolated by precipitation, washing and drying) could readily be redissolved in tetrahydrofuran at 25° C. to give solutions of η_{sp}/c identical with that of the *aged* solutions. Further, calculations of the approximate overall activation energy of the process, based on rates of change in η_{sp}/c of a solution in tetrahydrofuran at 50° C. and 75° C., gave a value of about 24 kcal. Neither of these observations is conclusive in itself, but taken in conjunction with the results already quoted, they inevitably suggest that primary valency bonds are being broken.

Sufficient evidence is not yet available for a discussion of the mechanism of this degradation, but a study of the rate of change of peroxide content in tetrahydrofuran, in contact with air, both with and without dissolved copolymer, has given some indication that the initial attack on the polymer may be by a radical produced during solvent autoxidation reaction[5], or by hydroperoxide fission.

The number of points in the copolymer molecule at which attack is possible may be limited, because copolymer isolated from solutions which have been aged to constant η_{sp}/c value at a particular temperature, when redissolved in fresh solvent containing

peroxide, undergoes little or no further change when aged at the same temperature.

One of the objects of publishing these results is to direct attention to the possibility of error arising during viscosity and other measurements performed on solutions of polymers in solvents able to form peroxides by autoxidation. Detailed results will be published elsewhere at a later date.

We acknowledge helpful discussions with Dr. H. P. Staudinger and Mr. C. E. Hollis in the course of this work.

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Trichothecin: an Antifungal Metabolic Product of *Trichothecium roseum* Link

Antagonistic activity to other fungi by *Trichothecium roseum* Link (syn. *Cephalothecium roseum* Corda) has been reported by Whetzel[1], Boning[2], Koch[3] and Greaney and Machacek[4]. Culture filtrates of *T. roseum* have been shown to inhibit germination of *Botrytis allii* conidia[5]. We have isolated the substance responsible for this activity in crystalline form in yields of 20–30 mgm. per litre of culture filtrate. The name 'trichothecin' is suggested for the active substance.

The most satisfactory yields have been obtained by growth of the fungus for a period of 28 days at 25° C. on a modified Czapek-Dox medium, in which sodium nitrate was replaced by the equivalent quantity of ammonium tartrate. The medium contained 5 per cent of glucose and was supplemented by the addition of 1 per cent of corn-steep liquor. The development of antifungal activity was followed by means of a spore-germination assay using *Penicillium digitatum* conidia. Maximum concentration of trichothecin (40–50 mgm./l.) was attained after about 28 days.

Trichothecin was extracted from the culture filtrate with ether or chloroform and purified by chromatographic methods on activated alumina. It was finally recrystallized from light petroleum (b.p. 60–80°) and formed long, slender, colourless needles, m.p. 118°, which were optically active $[\alpha]_D^{18} + 44°$ (*c*, 1 in chloroform). It contains neither halogens, sulphur nor nitrogen. Microanalyses (Weiler and Strauss), found: C = 68·5, 68·7, 68·8 per cent; H = 7·2, 7·3, 7·4 per cent; mol. wt. (Rast) = 278. $C_{15}H_{18}O_4$ requires: C = 68·2 per cent; H = 7·5 per cent; mol. wt. = 264. $C_{15}H_{18}O_4$ requires: C = 68·7 per cent; H = 6·9 per cent; mol. wt. = 262. The compound is neutral and only slightly soluble in water (*c.* 400 mgm./l. at 25°) but readily soluble in most organic solvents. The molecule contains one ketonic group and one ethylenic group. These observations are supported by the ultra-violet absorption spectrum of trichothecin, which also suggests that the two groups are conjugated. No other functional groups have been detected. Methyl attached to carbon determination (Weiler and Strauss), found: (C)CH_3 = 16·4 per cent; 3 × (C)CH_3 groups require 17·0 per cent. There is no evidence of an aromatic nucleus.

At a concentration of 400 mgm./l. and *p*H 7·0, trichothecin was inactive against *Staph. aureus*, *B. subtilis* and *Bact. coli*. Its antifungal activity is exhibited against Fungi Imperfecti, Zygomycetes and Ascomycetes. The growth of each of some twenty-five species belonging to the above classes was inhibited to a greater or lesser degree. *P. digitatum* is the most sensitive species so far examined; germination of conidia was completely inhibited by 1·25 mgm./l. of trichothecin, and 50 per cent germination took place at a concentration of 0·30 mgm./l. The corresponding data for *Botrytis allii* spores are 6·25 and 3·12 mgm./l. Growth of the following fungi on beer wort agar was completely suppressed by the trichothecin concentrations given in parentheses: *P. digitatum* (0·64 mgm./l.), *Fusarium graminearum* (16 mgm./l.), *Paecilomyces varioti* (80 mgm./l.), *Saccharomyces carlsbergensis* (16 mgm./l.), and *Mucor erectus* (80 mgm./l.). *T. roseum* showed a partial reduction of growth at a concentration of 80 mgm./l.

Aqueous solutions of trichothecin were stable at *p*H 1 to *p*H 10 for at least 48 hours at 20°. At *p*H 12 the antifungal activity was rapidly destroyed even at room temperature. Aqueous solutions at *p*H 7 were maintained for at least one hour at 100° without detectable loss of activity.

Full accounts of the preparation and chemical and biological properties of trichothecin will be given elsewhere.

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Role of the *Y*-Chromosome in the Determination of Cell-size in *D. melanogaster*

I have already pointed out[1] that in wild stocks of *D. melanogaster*, Gaiano (Parma), Luino (Varese), Civate (Como), the unicellular hairs of the upper wing surface, counted in a standard surface of 298 μ^2 for each wing, show frequency differences. Furthermore, there are sex differences of different kinds in the three stocks, being highest in Gaiano, intermediate in Civate and lowest in Luino. This shows the possibility of an action of the *Y*-chromosome, already proved by Mather[2] for the chætæ also in *D. melanogaster*.

For this purpose I considered the Oregon *R* stock, which showed a very strong sex difference in addition to another cell character, namely, the eye corneolæ. The surface was measured directly[3] in ten ommatidia of one eye (either the right or the left one, both being significantly similar) in each individual, and the mean was calculated. (The complex of the corneolæ of one eye was prepared after treatment in potassium hydroxide of the entire eye, and mounted in glycerine; the wings also were mounted in glycerine.) The following figures are the mean for thirty flies; the standard errors are indicated.

Oregon *R*:	*hairs*	♀ 16·06±0·58	♂ 20·60±0·60	Diff. 22·50%	(significant)
	corneolæ ♀	847±20·7μ^2	♂ 732±14·9μ^2	Diff. 13·70%	(significant)
Luino:	*hairs*	♀ 21·25±0·28	♂ 21·83±0·75	Diff. 2·70%	(not significant)
	corneolæ ♀	681±30·0μ^2	♂ 697±29·0μ^2	Diff. 2·36%	(not significant)
Gaiano:	*hairs*	♀ 15·61±0·24	♂ 17·43±0·57	Diff. 10·45%	(significant)
	corneolæ ♀	732±15·30μ^2	♂ 689±20·05μ^2	Diff. 5·30%	(not significant)

The sex differences of the hair frequencies tested with Fisher's Z test are significant for Oregon and Gaiano, but not for Luino. The corneolæ are significantly different only in Oregon. Males from Luino and Gaiano were mated successively to Oregon females and the heterozygous males back-crossed to Oregon females for six subsequent generations, in order to make the stocks isogenic; they become in this manner 'oregonized', except for the *Y*-chromosome, if no crossing-over between *X* and *Y* occurred. This procedure was repeated twice, and every factor of the environment capable of inducing phenotypical variations (food, temperature, bottle volume, number of flies) was kept constant.

The mean values for both independently 'oregonized' stocks of Luino obtained from thirty individuals for each sex are:

Hairs	♀ (I) 17·70±0·59	♂ (I) 18·50±0·51	Diff. not significant		
	(II) 17·40±0·29	(II) 17·80±0·36	,,	,,	,,
Corneolæ	♀ (I) 830±19·0μ^2	♂ (I) 801±19·0μ^2	,,	,,	,,
	(II) 783±14·7μ^2	(II) 744±16·7μ^2	,,	,,	,,

The results for Gaiano are intermediate between Oregon and Luino, also after the 'oregonization'. It is interesting that the sex difference for the corneolæ (♀ 847 ± 26; ♂ 744 ± 45) of Gaiano is significant in this stock only after 'oregonization'. Both characters were measured in subsequent 'oregonized' generations, and only insignificant differences were found.

The data may be summarized as follows. Both characters are similarly influenced by the *Y*-chromosome, because the amount of the sex difference remains of the same order of magnitude, even when the euchromatin has been profoundly rearranged by the crosses. The *Y*-chromosomes of Oregon and Gaiano make the cells of the females larger, whereas the *Y*-chromosome of Luino does not induce any appreciable difference. On the other hand, the values obtained before and after 'oregonization' are different, and both characters in Luino are nearer to the Oregon ones in the latter stage. This proves the participation of the euchromatic chromosomes in the determination of the cell size.

These results agree with those obtained by Mather, and make it possible to go further in the functional interpretation of the heterochromatin. Actually, owing to the type of the characters considered, a connexion is established between the *Y*-chromosome and cell size, that is, between heterochromatin and cellular growth. This connexion is the same as that pointed out by Caspersson[3] using a quite different method. In fact, my experiments prove genetically that heterochromatin has a role of the same kind as direct observations of the cellular polynucleotides permit one to infer[4].

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Seaweed Culture

COMPREHENSIVE culture experiments of algal spores and ova have been carried out, and still more are in operation as part of the programme of research of the Scottish Seaweed Research Association. The principal object of this work is to ascertain the minimum requirements for the development and healthy growth of zoospores and zygotes of the brown algæ, yet at the same time departing as little as possible from natural conditions.

In the last experiment to be completed, zoospores of *Laminaria Cloustoni* were added to thirty small tanks containing either natural or artificial sea water, well aerated and circulated. Additional nutrients were dissolved in some tanks, light restricted in others, water remained unchanged in some cases and changed in others.

Among the many interesting results, it was found that the zoospores showed their greatest development when disodium hydrogen phosphate, sodium nitrate and sodium bicarbonate were added in combination to natural sea water unchanged during the experiment. Two embryo sphorophytes, which have developed from the zoospore through the gametophyte to the sporophyte stages in the above solution in 28 days, are shown in Fig. 1. Up to 32-cell stages were found after 36 days.

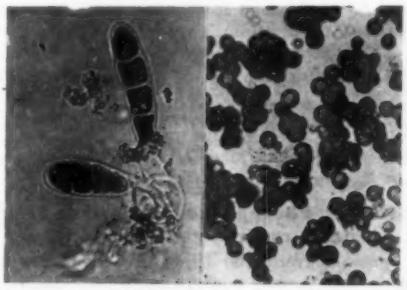

Fig. 1

Fig. 2

Fig. 1. SPOROPHYTE EMBRYOS OF *Laminaria Cloustoni*. 28 DAYS IN SEA WATER WITH ADDED PHOSPHATE, NITRATE AND BICARBONATE. × 350

Fig. 2. DEVELOPMENT OF *Laminaria Cloustoni* ZOOSPORES IN SEA WATER WITH ADDED URANIUM NITRATE. × 350

The surprising result of zoospore development of *L. Cloustoni* during the same experiments, when uranium nitrate was added to natural sea water unchanged during the experiment, is shown in Fig. 2. What was thought to be a precipitate of uranium proved to be a most prolific growth. More zoospores developed in this tank than in any of the others. The zoospores appear to have begun to develop into gametophytes at a rate far outstripping the normal. The nuclei in some cases have divided without subsequent development of the cell wall. The result is probably more 'cancerous than polyploid'. The nuclei are more conspicuous and take up a central position within the cell. The cell walls were hardened by the end of a month and the cells were killed at some time during this period, although their initial growth by division was stimulated. No living bacteria or protozoa were seen in this tank, although both were found active in most other tanks.

During the extensive seaweed survey of the Scottish coast[5] it was noticeable that the growth of Laminariæ was poor where *Ascophyllum nodosum* was abundant. It is also known that *A. nodosum*

will ultimately dominate virgin substrata initially colonized by *Fucus vesiculosus*. The senior author has long considered it a probability that *A. nodosum* might exude something which inhibits the development of competitive algæ, and to test this, zoospores of *Laminaria Cloustoni* were grown in natural sea water with a piece of living, mature *A. nodosum*. The water of this particular tank was noticeably clearer than any of the others, and inspection after 28 days showed the zoospores to be completely decolorized. (Of the marine aquaria maintained in the laboratory, the water of one containing *A. nodosum* sporelings always remains the clearest.)

From this, three points emerge: (1) *A. nodosum* produces an antibiotic; (2) the effects of this antibiotic in decolorizing the chlorophyll serves a useful means for more easily studying the nuclei of *L. Cloustoni*, which unfortunately are structurally minute; and (3) is the zonation of the littoral Fucaceæ due to 'chemical claws'?

The nuclei of the normal spores, the spores grown with uranium nitrate and *A. nodosum* appear visually similar. They comprise two small stainable masses within a sac of clear material.

Full details will be published elsewhere with full bibliography.

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Growth of *Phytophthora infestans* (Mont.) de Bary on Artificial Media

It appears from the literature on *Phytophthora infestans* that many workers have had difficulty in growing this fungus and in obtaining a supply of sporangia. The fungus grows and fructifies well on potato leaves and tuber slices, but such cultures require frequent renewal. Recently Snieszko *et al.*[1] in the United States described various media which supported growth, particularly a cereal grains – peanut hull mixture upon which the fungus spored freely. Peanut hulls are not readily available in Great Britain.

In this laboratory, media for the culturing of *P. infestans* have been made from germinated oats, wheat, maize and pea and from dried leaves of potato and tomato. At its best the dried potato leaf medium was much superior to all other materials tried. Sporulation was sometimes so abundant that cultures had a powdery rather than a downy appearance. Unfortunately, as with oat, wheat, maize and tomato, this medium was unreliable, often giving poor growth and sporulation. A reliable medium made from pea-flour has now been evolved. It is felt worth while to publish the information, although the method is by no means perfected.

This medium contains 2·5 per cent pea-flour, 2·5 per cent sucrose, 1 per cent agar and distilled water. The sucrose, agar and half the water are sterilized at 15 lb. pressure for 15 min., and to this is then added the pea-flour in the rest of the water heated to 40° C. After rapid and thorough mixing, the medium is tubed and plugged. The tubes are left at laboratory temperature for 18–24 hr., sterilized at 10 lb. pressure for 6 min. and sloped.

The pea-flour is made from garden peas grown in sand under glass. When the plants are 2–3 in. high, their leaves and stems are chopped up and dried on glass sheets in an electric oven at 55–60° C. The time taken for drying varies from two to three hours. The dried material is ground with a hand-mill and stored in screw-capped bottles in the dark.

This pea-flour medium has been in use for more than a year, and in no instance has the fungus failed to grow or sporulate on any batch of it. Some isolates of *P. infestans*, however, grow more rapidly and spore more freely than others. In test-tubes (6 in. by ¾ in., 5 ml. medium) at 18° C. the fungus usually covers the agar in a week and sporing begins in two to three weeks. Sporulation is greater if the cultures are stored in closed jars. The danger of mould contamination arising from these damp conditions can be avoided by exposing the cultures once weekly to room humidity for a few hours and replacing them in clean, dry jars. If the fungus is grown in boiling tubes (7 in. by 1 in., 15 ml. medium), good sporulation will take place even if the cultures are not kept enclosed. It is advisable, however, to keep them in jars until the fungus is well established.

Some isolates of the fungus survive longer in culture than do others. Test-tube cultures kept at 18° C. require subculturing every four to five weeks; at 10° C. every ten to twelve weeks. In boiling tubes, some cultures have remained alive for as long as seventeen weeks, whereas others have lasted only ten to twelve weeks.

Spores produced by *P. infestans* on this pea-flour medium have infected potato seedlings, tubers and adult leaves. The effect of continuous cultivation on the pathogenicity of the fungus is under investigation.

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Hysteresis in the Swelling of Gels

Hygroscopic natural fibres generally show sorption hysteresis, such that the vapour pressure at any given moisture content is higher on adsorption than on desorption, whereas no hysteresis is found in true solutions.

In 1942 I suggested[1] that sorption hysteresis in gels could be explained in terms of their plastic properties. This deduction is based on the fact that the vapour pressure of a gel is determined by the hydrostatic stress acting on it as well as by the moisture content. It can be shown[2] that, if either anatomical or molecular restraints oppose the free swelling and introduce plastic flow under shear stresses, the hydrostatic component p of the stress system, and therefore also the vapour pressure h, will be higher on adsorption than on desorption at any given moisture content m.

If, between adsorption and desorption, the difference in hydrostatic pressure is Δp, this must produce a change in volume of the gel: $\Delta V = -V\Delta p/k$, where k is the bulk modulus; while the value of

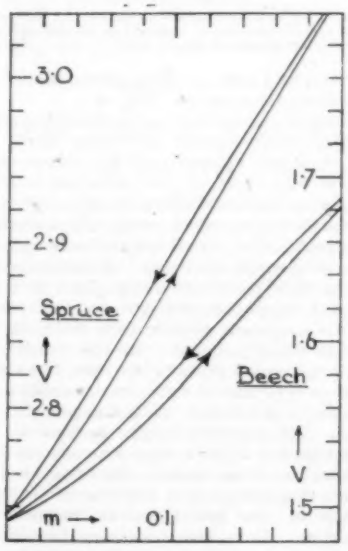
Units: $k = 10^{10} \times$ dynes/sq. cm.; V = c.c./gm. dry weight; m = gm. water/gm. dry weight.

	Solid fibres V (dry) = 0·0661 k 0·86		Spruce V (dry) = 2·731 (75·3% void space)				Beech V (dry) = 1·492 (54·8% void space)			
m	s_p	ΔV (calculated)	s_p	k	ΔV (calculated)	ΔV (observed)	s_p	k	ΔV (calculated)	ΔV (observed)
0·05	0·73	0·0045	1·58	2·55	0·020	0·016	0·833	3·37	0·0144	0·0081
0·10	0·90	0·0016	1·74	1·20	0·048	0·015	1·041	1·80	0·0253	0·0105
0·15	0·95	0·0008	1·62	0·70	0·054	0·008	1·087	1·05	0·0216	0·0119
0·20	0·98	0·0003	1·50	0·55	0·042	0·000	1·071	0·82	0·0185	0·0027

Δp can be obtained from the vapour pressures, h' on adsorption, and h'' on desorption, from the approximate relation $\Delta p = -(RT/Ms_p) \log (h'/h'')$, in which $s_p = (dV/dm)_p$ the differential volume swelling of the gel. Thus, if the origin of sorption hysteresis lies in plasticity, the volume swelling should show hysteresis if plotted against the moisture content, such that the volume will be smaller on adsorption than on desorption.

Calculations of ΔV can be compared with experiment by using the measurements of Hermans[3] on solid fibres of regenerated cellulose, or those on beech[4] and spruce, made in this Laboratory. Approximate values of k may be taken from calculations made here. In the case of the solid fibres these are incomplete, since the variation of k with m is not known and a single mean value must be used for all moisture contents.

The table gives these estimates of ΔV. For the solid fibres all values of ΔV (except at $m = 0{\cdot}05$, where k is most in doubt) lie below the limit of accuracy claimed by Hermans (0·002 c.c./gm.) and will therefore not be detectable. This agrees with Hermans' own statement that no volume hysteresis is found. For spruce and beech the values of ΔV lie well above the limit of accuracy and a hysteresis of this order of magnitude is found experimentally, as can be seen in the accompanying graph.



So far as I am aware, this graph records the only experiments so far made which show volume hysteresis in the swelling of gels. This is no doubt because in most solid gels, such as Hermans', k is large and the hysteresis is too small for easy detection; whereas in porous gels such as wood, k is much smaller and the hysteresis therefore more prominent.

The above calculation has tacitly assumed that the gel is plastic to shear stresses and elastic to the hydrostatic stresses. It can be shown both by theory and experiment[2] that some plasticity to Δp occurs in complex porous structures such as wood, so that some relaxation in Δp is to be expected. This effect would be more marked at the higher moisture contents where the wood is more plastic, and would account for the observed fall in ΔV to very small values in this region.

A full discussion of this subject is given in an internal unpublished Laboratory report, No. P.82 (1948).

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Fine Structure of the He II Line $\lambda = 4686$ A.

According to the Dirac theory of the energy states in hydrogen-like spectra, levels of the same principal quantum number n which have the same value of the quantum number of total angular momentum j should coincide. Lamb and Retherford[1] have shown that in the second quantum state of the hydrogen atom the $2\ ^2S_{1/2}$-level lies 0·03 cm.$^{-1}$ above the $2\ ^2P_{1/2}$ term. Bethe[2] has tried to explain this discrepancy by an interaction of the electron with the radiation field. His preliminary calculations show complete agreement with experiment for the hydrogen atom. For the He II spectrum he predicts a shift of the $3\ ^2S_{1/2}$-level with respect to the $3\ ^2P_{1/2}$-level by 0·13 cm.$^{-1}$.

We have investigated the fine structure of the He II line $\lambda = 4686$ A. ($n = 4 \rightarrow n = 3$) with a Fabry–Perot interferometer and have found that the $3\ ^2S_{1/2}$-level lies $0{\cdot}137 \pm 0{\cdot}015$ cm.$^{-1}$ above the value given by the Dirac theory. Greater accuracy has not yet been possible because of the breadth of the lines.

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THE CYTOLOGY OF THE HONEY BEE, *APIS MELLIFICA* L.

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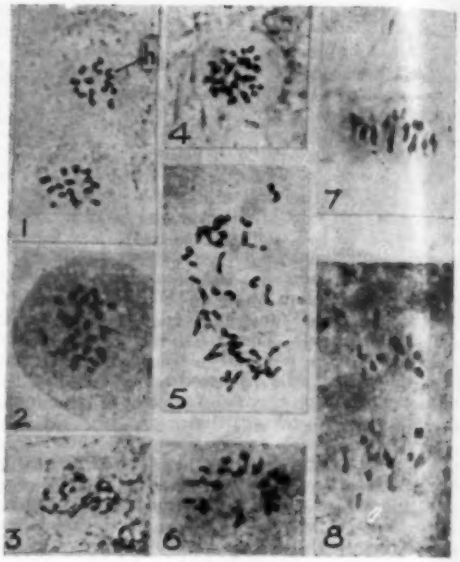
THE cytology of *Apis mellifica* L. has been investigated by Petrunkewitsch[1,2], Doncaster[3,4], Mark and Copeland[5], Meves[6], Nachtsheim[7,8], and Jegen[9]. Nachtsheim figures the chromosomes as spherical in shape, 16 in number in spermatocytes and oogonia, and reduced to 8 in the ootid. In his interpretation of the chromosome constitution of the male and female he resorts to a theory of "*Sammelchromosomen*", in which some chromosomes are said to be "*einwertig*" and others "*doppelwertig*". His cytological findings are so exceptional and the results of the workers mentioned above are so anomalous that they are open to criticism (see Sanderson[10]). Furthermore, on the basis of Nachtsheim's work, a theory that the drone bee is a diploid organism with a haploid germ tissue has been recently advanced by Whiting[11]. The problem obviously required re-investigation and this we have undertaken, using improved modern methods of fixation and of smear technique on abundant material.

The accompanying photographs of our material clearly show the chromosome number in male and female to be 16 and 32 respectively, and also the chromosomes to be mostly rod-shaped, not rounded as depicted by Meves, Doncaster and Nachtsheim.

Smears of larval testes fixed and stained in aceto-carmine or aceto-orcein yield convincing counts of gonial plates (Fig. 1). In these one chromosome is hooked and somewhat larger than the rest (Fig. 1, *h*); it is very striking in late anaphase. In oogonia two similar hooked chromosomes can be distinguished. These findings agree with the work of Granata[12,13] on the spermatogenesis of the carpenter bee, *Xylocopa violacea* L., where the 16 chromosomes are hooked and separate. In the honey bee we have never found the chromosomes lying in pairs in either male or female and we therefore suggest that the apparent pairing of chromosomes and formation of "*Sammelchromosomen*" found by Nachtsheim were due to the technique employed. Oogonial counts can be obtained from queen larvæ and pupæ (Fig. 4), and plates showing the same number, 32, can also be obtained from worker larvæ before the ovaries degenerate.

With regard to the abortive division of the spermatocytes, we confirm the observations of former workers that the chromosome number is not reduced during maturation, but we have not been able to confirm currently accepted views on bud formation.

Our investigation of egg maturation is still incomplete, but examination of some twenty spindles in smeared unfertilized eggs shows that maturation follows the usual method found in arrhenotokous saw-flies and other groups of insects. The first spindle lies near the margin in the broad end of the egg; in aceto-orcein squashes the chromosomes in metaphase and early anaphase appear to be viscous (Fig. 7); about 16 bivalents can be counted on the equator and, later, 16 chromosomes travel towards each end of the spindle; the daughter groups line up on two other spindles which appear to arise immediately, and some of these chromosomes already show chromatid formation (Fig. 8).



PHOTOGRAPHS OF MALE AND FEMALE TISSUES OF HONEY BEE, ALL TO SAME SCALE. FIG. 4 IS FROM A SERIAL SECTION STAINED WITH IRON HÆMATOXYLIN; ALL OTHERS FROM ACETO-ORCEIN SMEARS

Fig. 1. TWO SPERMATOGONIAL PLATES; 16 CHROMOSOMES; *h*, HOOKED CHROMOSOME

Fig. 2. DIPLOID PLATE IN MALE FOLLICLE CELL; 32 CHROMOSOMES

Fig. 3. MALE BLASTODERM CELL; ABOUT 16 CHROMOSOMES

Fig. 4. OOGONIUM; 27 CHROMOSOMES SHOWN

Fig. 5. FEMALE BLASTODERM CELL, LATE PROPHASE; ABOUT 32 CHROMOSOMES

Fig. 6. FEMALE BLASTODERM CELL, METAPHASE; 31 CHROMOSOMES SHOWN

Fig. 7. EGG MATURATION, FIRST SPINDLE METAPHASE; ABOUT 16 BIVALENTS IN FOCUS

Fig. 8. EGG, SECOND MATURATION SPINDLES; 15 CHROMOSOMES SHOWN IN LOWER METAPHASE PLATE, AND 15 CHROMOSOMES IN UPPER METAPHASE PLATE (3 DISPLACED TOP LEFT)

Regarding evidence of somatic numbers, male and female blastoderm smears distinctly show 16 and 32 (Figs. 3, 5 and 6), and here the chromosomes by comparison with those of germ cells are much longer and thinner, so that size differences are more apparent. Though further work is necessary, our material gives the impression that blood and muscle cells in the pupæ show normal numbers. Somatic polyploidy does occur in hypodermal, malpighian and tracheal cells, and follicular epithelium cells of testis and ovary. In the male, follicle cells with 32 (Fig. 2) or more commonly occur; in the female, follicle cells with the gonial number are rare, but the actual degree of polyploidy is not yet determined. Likewise, embryonic serosa cells frequently become polyploid. In contrast to the non-social Hymenoptera, where the male is conspicuously smaller than the female, the drone and queen honey bee do not show such disparity; the relation of body size to polyploidy in the bee therefore requires further investigation. It is also necessary to ascertain in what particular tissues polyploidy arises.

Our evidence establishes beyond doubt that the male is haploid, at least at the beginning of cleavage, in blastoderm stages and in the larval testis. Whiting,

basing his theory on Nachtsheim's figures, considers that the male and female honey bee are somatically diploid and tetraploid respectively, the haploid number being 8. Nachtsheim's results do not agree with those of Petrunkewitsch, who found 16 chromosomes in the oocyte, nor of Meves, who demonstrated 16 in the second spermatocytes, nor with our findings, especially those relating to oogonia and egg maturation. Furthermore, Nachtsheim's results have long puzzled cytologists, but since our new evidence clarifies the situation, Whiting's views on polyploidy in the bee appear inacceptable.

Our conclusions have been reached after a study of a wealth of material which permits us to stress the following points on honey bee cytology: (1) the well-defined shapes and individuality of the chromosomes; (2) their discrete arrangement at all times; (3) the haploid-diploid constitution of the male and female, the male having 16 and the female 32 chromosomes in gonial and in normal somatic cells; (4) the invalidity of Nachtsheim's evidence regarding "*Sammelchromosomen*"; and (5) the inacceptability of Whiting's theory on somatic polyploidy in the honey bee.

We wish to acknowledge indebtedness to Mr. D. Robb for the use of an observation hive, to Mr. D. Gauld, and to many other local beekeepers for their ready co-operation in supplying suitable material, and to Mr. H. R. Ness for invaluable help with the photography. Prof. A. D. Peacock, in whose department this work has been carried on, has throughout given helpful advice and criticism.

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VENEREAL DISEASE CONTROL IN POLAND

POLAND is at present faced with a venereal disease problem against which the state of affairs in Britain appears insignificant. The incidence of venereal diseases has increased enormously over the war years and the number of fresh infections with syphilis is now calculated to be about 150,000 per year. There is a decrease in live births of about 40,000–50,000 per year, the mortality-rate from syphilis being about 11 per cent. The reason for this state of affairs is not far to seek. The Germans spared little attention for the Poles whether they were in Poland or displaced to other countries. Venereal diseases were prevalent among displaced persons, and although plans were formulated before D-day for the treatment of infected persons before they were repatriated, nothing was, in fact, ever done for them.

The Ministry of Health in Warsaw has now prepared a permanent programme for venereal diseases control and a temporary programme for immediate operations. The basic units are consultation centres for skin and venereal diseases in health centres distributed throughout the country, and there are, of course, clinics in the hospitals of the major cities.

The basis is a network of medical facilities free to all. The principle of the legal basis is that every citizen with venereal disease can, if necessary, be compelled to submit to treatment. Sources of infection are to be discovered and put under treatment. Auxiliary measures include periodic surveys of persons susceptible to infection; obligatory pre-marital examination; obligatory serum tests for syphilis in pregnant women; training of medical personnel; propaganda; control of prostitution and vagrancy; control of alcoholism; and collection of statistics. Every physician, regardless of his status, is required to determine, and report to the nearest centre, all the sexual contacts of his patients during the infectious period. Persons so named are requested to attend the centre within seven days, and if there is no response a health visitor is to be sent. If this is still unavailing, compulsion is used. Mobile ambulance units are to be used in isolated districts for treatment, propaganda, mass observation, training, etc. Training courses, to be attended at least once a year by the medical men in centres, are to be held in the main provincial centres and will include diagnostic methods, modern treatment and management of complications, control and organisation, and propaganda organisation. Propaganda will consist in popular lectures, films and slides, posters and pamphlets and anti-alcohol appeals.

This programme is directed to the rapid treatment of syphilis during 1948. The old long-term treatment is discarded in early syphilis because of the high rate of default and possibility of continuing infectiousness. Use of penicillin reduces treatment to about two weeks and the infectious stage to about the same period; but there is a risk of infectious relapse in 15 per cent of cases.

It is proposed to do sample surveys of fifteen groups of a thousand people in various areas to gain information on prevalence and distribution of disease.

The importance of accurate serological examinations is recognized and a standard (flocculation) test is to be used throughout the country. Private laboratories are to be checked each year to ensure efficiency. Serological examination is to be routine on first diagnosis of pregnancy, and for military recruits, students and workers.

In the rapid treatment scheme every doctor, in public or in private practice, is to be employed. High standards in diagnostic technique are required.

Rapid treatment is to be given to all cases of symptomatic early syphilis and to cases of asymptomatic early syphilis (up to three years from date of infection) which have not previously been treated or which have received less than one standard course of arsenic and bismuth. The treatment is to consist of 3,000,000 units of penicillin in oil-beeswax suspension given in doses of 300,000 units each day for ten days. 0·2 gm. bismuth subsalicylate is to be given on the first, fourth, seventh and tenth days of treatment. The bismuth is omitted in pregnant women. Children are to receive 200,000 units penicillin per kilo body weight.

Intensive propaganda on the necessity for early treatment and systematic follow-up and on the availability of free treatment facilities is to be carried on by posters, newspaper articles, radio and films.

The rapid treatment method is only intended for use in the early stages of syphilis, early cases of latent syphilis, in pregnant women at any stage of disease, and in congenital syphilis, inadequately treated, up to the third year. Diagnosis is to depend on the finding of *Treponema Pallidum* by dark-ground examination, a positive serum test in the presence of clinical signs, or two positive serum tests in the absence of clinical signs if the history suggests an infection of less than three years duration.

Drugs are always available at centres; but a private practitioner receives supplies only after notifying a case and sending a requisition form. This will inevitably lead to delay in starting treatment in many cases. Private practitioners may charge a fee for treatment, but have to inform the patient that the drugs are supplied free.

Follow-up after treatment consists in clinical and serological examinations once a month for the first six months, every three months in the second six months, and each six months in the second year. The cerebro-spinal fluid is examined six months and two years after treatment. Failures after rapid treatment are to receive four courses of arsenic and bismuth on the long-term plan.

The examining physician must obtain from the patient particulars of all his contacts from the time of contracting the disease (eight weeks before the first sign in the case of syphilis) until the time of diagnosis. The patient is asked to try to bring for examination all such contacts; but methods of compulsion can be used as a last resort if persuasion is unsuccessful.

The theoretical basis of this plan is excellent, embodying as it does the latest features of Anglo-American practice. It is complicated in practice by the necessity for a formidable amount of documentation on the patient, treatment, drugs, follow-up, contacts, statistics, etc. Indeed, the paper-work will consume more man-hours than diagnosis and treatment, as was the case in the Services during the War.

The choice of treatment schedule has been influenced, no doubt, by considerations of time and availability of drugs. I do not consider, personally, that the addition of 0·8 gm. bismuth subsalicylate will increase the 'cure' rate. I believe it will do no more than delay the appearance of signs of relapse in cases which will fail. There is nothing to show that bismuth and penicillin are synergistic in action. The effect of penicillin during a rapid treatment would be more likely to be enhanced by the addition of arsenic (as an arsenoxide for preference) to the schedule. This idea has, no doubt, been discarded because of the slight risk of arsenical toxic effects and because of its technical difficulties. Arsenicals have to be administered intravenously, and it is probable that Poland at the present time lacks the skilled personnel necessary to cope with these added difficulties in the vast numbers of cases to be treated.

The choice of 3,000,000 units as the total dose of penicillin is again, no doubt, governed by circumstances; but it is a minimal effective dose and ought to be doubled as soon as supplies are available. With an infectious relapse-rate estimated (conservatively in my opinion) at 15 per cent, the follow-up programme must be very carefully carried out and failures re-treated without delay if an end state worse than the original is not to follow an initial apparent success.

The Polish medical authorities are to be congratulated on a carefully prepared and ambitious plan which seems to cover the immediate needs and make a basis for a useful service in the future. The statistical service may prove of great value in the rapid assessing of any treatment schedule, and it is to be hoped that if it is a success the system will be used for comparative experiments in treatment.

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DECARBOXYLATION OF OXALACETATE BY BLOOD

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EVOLUTION of carbon dioxide from oxalacetate by washed rabbit erythrocytes at *p*H 7·4 has been reported previously[1]. Because of the solubility of carbon dioxide at that *p*H, this could at best be only a qualitative indication of the decarboxylation. Working in either phosphate or 2*M* acetate buffer, and measuring carbon dioxide formation by the standard Warburg technique, the process has been thoroughly investigated.

The process is found in the following constituents of rabbit blood, either freshly drawn or stored for periods (up to several days) on ice: whole blood, erythrocytes, erythrocyte hæmolysate, plasma and acetone powder extracts of all the aforementioned. Hæmolysates were usually the most active, whole blood, erythrocytes and plasma roughly equally active, and acetone powder extracts all slightly less active.

At *p*H 6·5, no decarboxylation of either α-keto-glutarate or pyruvate was observed, whereas oxal-acetate decarboxylation was considerable; thus the system seems to be specific for that substrate.

Dialysis for 20–24 hours against distilled water caused reduction in activity. Whereas neither manganous ions (Mn^{++}) nor magnesium ions (Mg^{++}) had any influence on the decarboxylation by any of the above preparations prior to dialysis, partial restoration of activity in dialysed extracts was observed by fairly high concentrations (10^{-3} *M*–10^{-2} *M*) of manganous ions, and, less markedly, magnesium ions. Thiamine does not feature in the process under the experimental conditions employed. Added pyruvate in no way affects carbon dioxide output, so that the reaction does not seem to be a Krebs condensation to cis-aconitate. The process is not markedly reduced by submersion of the enzyme in water baths at 70–75° C. for periods of 1–4 min.

It must be noted that oxalacetate itself undergoes a quite rapid autodecomposition under the experimental conditions. This is very sensitive to *p*H and varies somewhat for each different oxalacetate solution, so that all experiments were invariably run with duplicate blanks containing only the appropriate buffer and the substrate. Influence of *p*H on autodecomposition of oxalacetate is shown below, that at *p*H 7 being taken as 100 for comparative purposes:

*p*H	3·5	4·0	4·5	5·0	5·5	6·0	6·5	7·0
Decarboxylation	300	280	250	180	150	150	130	100

All references made to decarboxylations are to be taken as *increases* above the autodecomposition rate, obtained after duly correcting for autodecomposition blanks.

It is suggested from the following experiments that two different mechanisms (*apart* from autodecomposition) may operate in blood under certain conditions.

Examination of the effect of *p*H showed that decarboxylation occurred for the full range tested, namely, *p*H 8·4–3·5. No experiments were carried out at *p*H values lower than 3·5. It was seen that, at the latter *p*H, very great activity is still obtained in both hæmolysates and plasma. Actually, that of the hæmolysate is definitely greater at *p*H 3·5 than at any other *p*H tested, in spite of the very large correction due to the autodecomposition, whereas plasma seemed to show optimal activity between *p*H 4 and 5. Since it seems almost certain that an enzyme of this type would not have a *p*H optimum at 3·5 (or even below this value), the existence of a second, non-enzymatic mechanism is suggested under conditions of very low *p*H. This suggestion is very strikingly supported by the following experiments in which the system was first boiled at a certain *p*H, and the decarboxylative activity afterwards determined at the same *p*H (after readjustment, if necessary).

Boiling acetone powder extracts or diluted hæmolysates at *p*H 6·5 for less than 1 min. causes almost complete cessation of the ability afterwards to decarboxylate the substrate. However, boiling the same hæmolysate or plasma samples at *p*H 3·5–4·0 not only failed to cause such reductions in activity, but usually, especially in the case of hæmolysates, a *more rapid* decarboxylation for the boiled sample was observed when compared with an unboiled control.

To account for these consistent, unusual results, the following hypothesis is suggested. At physiological *p*H, decomposition of oxalacetate is brought about by an enzymatic, heat-labile process, in which manganous ions and, to a less extent, magnesium ions, but not thiamine, are involved. The system may thus be similar to the enzymes in pigeon liver described by Evans *et al.*[2] and in bacteria by Krampitz and Werkman[3]. In more strongly acid solutions, however, a heat-stable decarboxylation appears which is due to the liberation of some substance previously not present in a free state. *This liberation is definitely accelerated by boiling in acid solution*, so that boiled samples show a more rapid evolution of carbon dioxide than the corresponding unboiled controls.

The spontaneous decomposition of oxalacetate was then further investigated in order to throw some light on this second, non-enzymatic mechanism. It was found that both manganous ions (Mn^{++}) and magnesium ions (Mg^{++}) at concentrations of 10^{-3} *M* considerably increase the autodecomposition of oxalacetate at *p*H 6·5, the former up to 75 per cent, the latter up to 40 per cent. At a final concentration of 10^{-5}, however, these effects were much less pronounced. Ammonia, considerable amounts of which are undoubtedly released during boiling at strongly acid *p*H values, did not affect the process in concentrations of 10^{-2} *M*–10^{-1} *M*, and therefore does not feature in the second process. These experiments also were carried out at *p*H 6·5. Finally, it was thought that iron, which may well be formed from hæmoglobin at low *p*H values, might account for the increases observed. It was found that, for both ferrous and ferric ions at final concentrations of 10^{-3} *M*, increases of nearly 100 per cent over a period of one hour occurred. Ferric iron appeared to be the more active of the two, and dilution of both to 10^{-5} *M* did not reduce the effect nearly as greatly as was found with magnesium and manganous ions.

It thus appears that inorganic ferric iron may account for at least a part of the second, non-enzymatic decomposition of oxalacetate observed at very low *p*H values. However, other metals or factors, such as Breusch's heat-stable tissue extract[4], cannot as yet be excluded.

Full details of this work will appear in the *Australian Journal of Experimental Biology and Medical Science*, and further work in connexion with both mechanisms is still in progress.

I wish to express my gratitude to Prof. J. G. Wood for a generous supply of the substrate, to Prof. M. L. Mitchell for continuous advice, and to M. Wellby for technical assistance.

[1] Nossal, P. M., *Aust. J. Exp. Biol. Med. Sci.*, **26**, Part 2 (In the press).
[2] Evans, E. A., Vennesland, B., and Slotin, L., *J. Biol. Chem.*, **147**, 771 (1943).
[3] Krampitz, L. O., and Werkman, C. H., *Biochem. J.*, **35**, 595 (1941).
[4] Breusch, F. L., *Biochem. J.*, **33**, 1757 (1939).

AMERICAN PHILOSOPHICAL SOCIETY

ANNUAL REPORT

THE yearbook for 1947 of the American Philosophical Society, Philadelphia, Pa., covering the year January 1–December 31, 1947, is a useful reference work, with its list of officers and committees, as well as of members, biographical memoirs (including those on Joseph Quincy Adams, Irving Fisher, M. Ganberg, P. Janet, H. S. Jennings and M. Planck) and reports of meetings. A brief history of the Society by E. G. Conklin, and the charter and laws are also included.

The report of the Committee on the Library records further accessions of more material relating to Benjamin Franklin and refers to progress during the year in the American Indian linguistic projects. At a conference called on October 18, 1947, to co-ordinate a programme in American archæology with that in linguistics, it was decided to restrict the area to be studied to the Iroquois and allied groups, and to compile a union list of Indian manuscript material as well as a manual for the use of amateur archæologists for the Iroquois area.

The report of the Committee of Publications gives some details of the foreign exchange list at December 31, 1947, revision of which has continued. In addition to the European libraries, a list is being drawn up of institutions in Latin America which should be placed on the regular exchange or on a temporary list for one year. Thirty-four papers were accepted for publication in the *Proceedings* during the year, as well as seven monographs for the *Transactions* and one book for the *Memoirs*; two new volumes of the latter were issued in 1947. A list of publications during the year is appended to this report.

The report of the Committee on Research details the general principles adopted by the Committee in regard to grants and lists of the eighty-nine grants, totalling 80,103 dollars, made from the Penrose Fund during the year, with an analysis of the distribution by subjects and a summary of grants made from July 31, 1933, to December 31, 1947, totalling 846,605 dollars. A further nine grants, amounting to 8,300 dollars, were made from the E. R. Johnson Fund, and twenty-two grants, amounting to 46,610

dollars, from the Reserve Fund for Post-War Expenditures. Among the reports from recipients of grants included in this yearbook are those from E. Hille on studies in the theory of semi-groups; W. A. Hiltner on photo-electric observations of selected Wolf-Rayet stars, the polarization of the continuous radiation from early-type stars and selected eclipsing variable stars; and from F. B. Wood on photo-electric observations of eclipsing binaries. F. F. Cleveland reports on his studies on molecular spectra and molecular structure of olefins, acetylenic compounds, diastereoisomers, hexachloroethane, hexabromoethane and other compounds, C. P. Harnwell on the construction of a new type of beta-ray spectrograph to investigate the beta-ray spectra of radio-elements emitting electrons and positrons, and H. H. Nielson on high-dispersion measurements on the infra-red spectra of the polyatomic molecules of hydrogen sulphide, acetylene, difluoromethane, dimethylacetylene, arsine and deuteroarsine. Work is described by E. Berliner on the competitive bromination of alkylbenzenes for the purpose of ascertaining a possible conjugation of alkyl groups with the benzene ring, by J. L. and E. M. Irvin on the apparent acid dissociation constants, quinoline antimalarials such as 'Pamaquine' and other 4-amino- and 4-hydroxyquinolines, and by J. F. Mead on the action of lead tetra-acetate on amino-alcohols and amino-glycols.

Studies in chemical embryology are reported by J. L. A. Brachet, on the quantitative spectrographic analysis of salt metabolism in developing *Fundulus* eggs and senescent *Drosophila* by O. C. Glaser, and on isolated embryonic amphibian cells with special reference to cellular structure, motility, aggregation and differentiation, and embryonic cell inclusions, particularly of yolk, lipochondria and microsomes by J. F. K. Holtfreter. A serological investigation of speciation and evolution, using the Libby photron-reflectometer, has been made by P. A. Moody, and experimental studies on the development of structure and function in the central nervous system of *Fundulus* embryos by J. M. Oppenheimer indicate that metrazol has a selective action on the cell-layers nearest the central canal. C. W. Clancy's investigation of the development of eye colour in *Drosophila melanogaster* suggests that the wild type allele of the vermilion gene is not only concerned with the reactions leading to the formation of the brown pigment component but also in some unknown way with the formation of the red pigment. J. F. Crow reports on the different susceptibility to ether of several closely related *Drosophila* species, H. Geiringer on the theoretical genetics of multivalent organisms, H. P. Hansen on post-glacial forest migrations and climate in Western Canada, and Ching Tsao Wei on the seed-borne diseases of soya beans. C. R. Procter has made an ecological study of a group of ferns, *Dryopteris cristata* and its relatives, in the eastern United States, and E. Girden a phylogenetic comparison of experimental drug dissociation. The electrical responses of the human retina to stimulation by light of various wave-lengths has been studied by L. A. Riggs, the application of the concepts of servo-theory to biological systems by C. L. Kreezer; and the specificity and sensitivity of a further fifty colorimetric tests for eighteen amino-acids by A. P. Kline.

In the field of social sciences, studies of wholesale commodity prices in Philadelphia during the Revolutionary War and of industrial relations in Norway are reported; and, in that of the humanities, of the prehistoric archæology of the Tangier area of Morocco, preliminary excavations at Cottonwood Cave and Pueblo, Colorado, the distribution of petroglyphs in the United States and the archæology of Marajo Island, Brazil.

WEST AFRICAN SEA-FISHERIES

MR. G. A. STEVEN'S report of his work*, as the sole fisheries development officer, under acute difficulties of war-time conditions, in Sierra Leone, a Colony where the sea-fisheries were almost entirely undeveloped, has now been published. It should prove a most valuable guide to Mr. Steven's successors, and leaves one profoundly hoping that they will find their path made smoother for them.

There is little doubt that the sea-fisheries in these undeveloped regions could be made to yield a vastly greater contribution to the sadly inadequate proportion of protein in the local diet. The small-scale trawling experiments with the *Maid Honor* (Skipper R. E. Brown) showed a yield of 86 lb. per hour from a 64-ft. headline trawl, which is sufficiently encouraging. In pre-war years a large British trawler with (say) 110-ft. headline gear, and vastly more expensive to run, could pay her way on double that yield. Since the report was written, we have been verbally informed that *Maid Honor*, still working in the same locality, is paying her way handsomely.

Fish are there in trawlable quantity, building of vessels up to the size of small motor-trawlers seems to be possible in the Colony and—probably Mr. Steven's most valuable achievement—a local team of net-makers was speedily trained to make good trawls and trammels. Machinery, of course, must be imported, but the only weak spot in the local contribution towards an incipient industry would seem to be need for further training of African seagoing trawlermen in repairing nets at sea.

One big question concerning the ground-fish remains unanswered: in the absence of fundamental knowledge of the ecology of those seas, we have no idea how much fishing the stocks can stand. Hence should any considerable industry develop, it must be controlled by guess-work, until some marine biological survey is completed. Mr. Steven justly points out that such surveys are beyond the resources of the smaller individual Colonies, for a central laboratory of some size and an ocean-going research vessel would be essential. Probably the subsequent working-up of the material would be best carried out in Great Britain, for a long experience of marine biological work overseas has left the present writer painfully aware of the almost complete absence of library facilities outside Europe (and the United States), apart from a very few of the larger cities in the greater British dominions.

Until these essential long-term researches are well advanced (which must take years of patient endeavour), there is no practical alternative to Mr. Steven's view that development officers must just go ahead developing as well as they can, and controlling as seems locally expedient; but the danger of bad or inadequate controls, when the cart is thus put before the horse, is very considerable. Mr. Steven admits this; but having worked in an area that seems

* Report on the Sea Fisheries of Sierra Leone. By G. A. Steven. (Freetown, 1945; London: Crown Agents for the Colonies, 1947.)

to be unusually rich (from what little one knows of the fish populations of warm seas) he does not emphasize the danger of over-fishing tropical stocks, on the sudden introduction of efficient European methods, so strongly as the reviewer would have done. Probably this was because it was only too obvious at the time of Mr. Steven's tour that there could be no suggestion of over-fishing with the inadequate equipment at the disposal of the Colony; but a recent example of the type of trouble that must be guarded against has been the very rapid development of an over-fishing problem in the Australian shark fishery.

Mr. Steven's descriptions of existing native fishing practice are most interesting, and must be of great value to those about to undertake similar tasks in the Colonies. The Clupeoids, so far as is known, withstand intensive exploitation better than ground-fish, and here development of the *bonga* fishery could probably proceed a very long way without danger to the stocks.

The great difficulties of preservation, processing and storage of fish in a climate which is very humid as well as hot should be more clearly visualized by all concerned in such matters (as, for example, those responsible for fixing the price of ice). The demonstration that dehydration may give better value than canning for local purposes amounts to a challenge to the technicians to devise economic means for the large-scale dehydration of fish under the most adverse climatic conditions.

The biologist will follow the report more easily after reading the very brief account of the principal food-fishes of the area, giving scientific as well as local names, in one of the previous Government publications by Hornell[1], to whose pioneer work Mr. Steven refers in his introduction. That so long an interval elapsed between Hornell's report and Mr. Steven's appointment to follow it up is most regrettable.

T. J. HART

[1] Sierra Leone Studies, 14 (1929).

CHEMICAL INDUSTRIES IN SCOTLAND

THE report of a committee appointed in May 1945 by the Scottish Council on Industry (20 George Street, Edinburgh. Pp. 39. 2*s.*) to inquire into the present conditions and post-war prospects of the chemical industries of Scotland and to recommend action to the Scottish Council is based on a survey made in 1945–46, and its publication has been considerably delayed. The section dealing with research has been rewritten; but the main recommendations and findings of the Committee remain unchanged in spite of the delay. The Committee made no attempt to define a chemical industry but limited the report to those industries covered under the various sections of *British Chemical Abstracts B*, excluding, however, those sections such as iron and steel, metallurgical industries and fuel, which were being studied elsewhere. Figures quoted in the appendix show that so far as explosives are concerned the proportion of operatives employed in Scotland is well above that calculated on a United Kingdom population basis, while in the chemical industry in general the proportion is well below this figure. The Committee, however, has throughout taken the view that Scotland cannot be treated as a separate entity when industrial development is under consideration. It has endeavoured to take a broad view and believes that any expansion of chemical industry in Scotland would have beneficial repercussions on the national economy of the whole of Britain. It also urges that a survey of an industry which so markedly depends on research involves consideration of the research facilities available in Scotland at present.

A survey of research facilities constitutes an important section of the report. This survey leads the Committee to believe that there is scope for a much more intensive application of research to problems of particular importance to Scotland, and that much of this research is of a kind which might properly be undertaken by a Government laboratory or by a research association. The principal recommendation of the report is, in fact, the formation of a chemical research committee, with representatives from industry, academic institutions and existing research associations, to formulate the problems of chemical research and development which require investigation to meet Scottish needs, to survey the facilities available for their investigation and to make recommendations for extending those facilities where required. Next, the Committee concludes that many firms have been, and still are, suffering from a shortage of labour and sometimes of technological skill. The diversity of the operations required of the workman in any manufacturing chemical process demands a high quality of labour, and on this point a conference is recommended between representatives of the Ministry of Labour and of the chemical manufacturers. Furthermore, chemical manufacturers on the whole do not yet appreciate the advantages to be derived from more adequate scientific control of chemical operations; and the Committee also recommends that their attention should be directed to the large number of graduates in pure and applied science who qualify at the Scottish universities and technical colleges every year, only ten per cent of whom at present find employment in Scotland.

Extension of the work of the Geological Survey so as to accelerate the rate of progress is recommended, and this should be given wider publicity. Indigenous raw materials such as limestone, quartz, felspar and baryta should be critically examined by the suggested chemical research committee and industrialists with the view of their utilization in new chemical development, and steps should be taken to bring the possibilities of chemical manufacturing development under the North of Scotland hydro-electric schemes before the industry. The refining and cracking of crude mineral oil in Scotland should be extended considerably and coupled with a more exhaustive utilization of coal tar as a source of chemicals. Further exploration of the potentialities of such processes as the Robinson–Brindley or the Fischer–Tropsch for organic synthesis is also recommended. Stress is laid on the importance of a substantial reduction in the cost of coal and of easing the situation in regard to Government control of raw materials and housing. Conditions for expansion of export trade are regarded as good, but conference with shipping interests is recommended on measures to avoid the burden on manufacturers caused by the tendency to transfer Scottish manufactured material to southern ports for shipment abroad.

In regard to particular industries, the Committee hopes that the newly formed Coal Tar Research Association will find a place within its organisation for a section operating in Scotland where, owing to

differences in coal and methods of carbonization, special problems have to be tackled; and also that the enormous post-war demand for all types of glass will be met in part by a general expansion of the Scottish industry. Scotland should also have a considerable share in the expansion of the dyestuffs industry; but the future of the papermaking industry in Scotland is bound up with the renewed importation of esparto grass and wood pulp. The development in Scotland of viscose, other types of rayon, or entirely new fibres from vegetable protein or alginic acid, must depend entirely upon economic factors, but special attention is directed to glass fibre. There appears to be room for a steady expansion of the rubber industry in Scotland generally, in addition to developing the export market, and it is strongly urged that actual manufacture of synthetic resins should be established in Scotland. The extraction of natural drugs could well be expanded in view of the great opportunities for export, and synthetic vitamins should find a place in the well-established fine chemical industry.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, July 5—Friday, July 9

IRISH CHEMICAL ASSOCIATION (in the Department of Chemistry, University College, Dublin), at 10 a.m.—Summer School in Chemistry.

Tuesday, July 6

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS GROUP (at Manson House, 26 Portland Place, London, W.1), at 6.30 p.m.—16th Annual General Meeting: Dr. Emil Ott: "The Relation of Physical Characteristics and Chemical Structure of Cellulose Derivatives".

Wednesday, July 7

BRITISH SOCIETY FOR RESEARCH ON AGEING (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 11 a.m.—Conference.*

Thursday, July 8

SOCIETY FOR ENDOCRINOLOGY (in the Clinical Lecture Theatre, Middlesex Hospital Medical School, London, W.1), at 5 p.m.—Prof. Edwin B. Astwood: "Recent Advances in the Physiology of the Thyroid Gland".*

Thursday, July 8—Saturday, July 10

INSTITUTE OF PHYSICS, MANCHESTER AND DISTRICT BRANCH (in the Physics Department, The University, Oxford Road, Manchester).—Conference on "Semiconductors and their Applications".

Thursday, July 8

At 2 p.m.—"The Physics of Semiconductors".

Friday, July 9

At 9.30 a.m.—"Industrial Developments"; at 2 p.m.—"Applications".

Saturday, July 10

At 9.30 a.m.—Informal Discussions, Demonstrations and Exhibits.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SCIENTIFIC OFFICER IN THE CHEMICAL RESEARCH DIVISION of the Ministry of Agriculture—The Assistant Secretary (Establishment), Ministry of Finance, Stormont, Belfast (July 9).

ASSISTANT KEEPER (Class II)—The Director, The London Museum, St. James's, London, S.W.1 (July 9).

ENTOMOLOGIST to work on the biology and control of the Pea Aphis, and an ENTOMOLOGIST to assist with investigations on the biology and control of the Pea Moth and to work on the development of methods of pest control—The Secretary, School of Agriculture, Cambridge (July 10).

SENIOR OBSERVER and a JUNIOR OBSERVER—The Director, The Observatories, Cambridge (July 10).

ASSISTANT PLANT PHYSIOLOGIST, ASSISTANT POMOLOGISTS (2), and an ORGANIC CHEMIST for fruit products investigations, at the Long Ashton Research Station—The Secretary and Registrar, The University, Bristol (July 10).

ASSISTANT LECTURER IN ZOOLOGY—The Registrar, The University, Leeds 2 (July 10).

LABORATORY ASSISTANT (Grade II) IN THE DEPARTMENT OF PHYSICS—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (July 10).

SENIOR LECTURERS OR LECTURERS (2) IN THE DEPARTMENT OF ENGINEERING—The Registrar, The University, Manchester 13 (July 10).

PUBLIC ANALYST—The Town Clerk, Town Hall, Bolton, endorsed 'Public Analyst' (July 10).

LECTURER IN THEORETICAL PHYSICS—The Registrar, King's College, Strand, London, W.C.2 (July 12).

LECTURER IN ARCHÆOLOGY—The Secretary, Queen's University, Belfast (July 13).

ASSISTANT IN GEOGRAPHY—The Secretary of University Court, The University, Glasgow (July 15).

SENIOR LECTURER OR LECTURER IN THEORETICAL PHYSICS—The Registrar, The University, Manchester 13 (July 17).

SENIOR RESEARCH OFFICER OR RESEARCH OFFICER (Ref. No. 1769) to undertake research into the chemical composition of Australian pasture plants, a RESEARCH OFFICER—Ecology (Ref. No. 1769)—to undertake research on pasture ecology, and a RESEARCH OFFICER—Agrostology (Ref. No. 1770)—to conduct research into the establishment and management of sown pastures, Division of Plant Industry, Canberra—The Secretary, Australian Scientific Research Liaison Office, Africa House, Kingsway, London, W.C.2, quoting appropriate Ref. No. (July 24).

CHIEF CHEMIST, and a RESEARCH OFFICER for enzyme chemistry, physical chemistry, X-Ray crystallography, and infra-red spectroscopy—The Secretary, Wool Industries Research Association, Torridon, Leeds 6 (July 24).

SENIOR ANALYST, an ANALYST, and an ANALYST (Biochemist), in the City Analyst's Department—The Town Clerk, Municipal Buildings, Dale Street, Liverpool, with the appropriate endorsement (July 26).

MECHANICAL ENGINEERS (3, Principal Scientific Officer grade) in the Royal Naval Scientific Service, for (*a*) design and development of torpedoes, (*b*) work on small control mechanisms, and (*c*) work requiring a sound knowledge, both practical and theoretical, of steam generating plant and prime movers—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2186 (July 31).

CHAIR OF ARCHITECTURE AT NATAL UNIVERSITY COLLEGE—The Secretary, Universities Bureau of the British Empire, 8 Park Street, London, W.1 (July 31).

HEAD OF THE METALLURGY DIVISION at the Atomic Energy Research Establishment—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2184 (July 31).

CHAIR OF CHEMISTRY—The Secretary, The University, Aberdeen (July 31).

CHAIR OF PHYSICS in the University of Adelaide—The Registrar, The University, Adelaide, South Australia (August 15).

MECHANICAL ENGINEERS, PHYSICISTS OR METALLURGISTS for research on mechanical working problems generally, including rolling, drawing and forging, and MECHANICAL ENGINEERS to assist in research on mechanical working problems generally, in the Metal Flow Research Laboratory—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1, endorsed 'Metal Flow'.

LABORATORY ASSISTANT OR TECHNICIAN with experience in some field of biological laboratory work, and a SPECIAL HISTOLOGICAL TECHNICIAN for a new research programme on radioactive tracer elements—The Professor of Zoology, The University, Bristol.

GOVERNMENT CHEMIST in the Medical Department of the Gold Coast—The Director of Recruitment, Colonial Service, 15 Victoria Street, London, S.W.1.

TECHNICAL RESEARCH ASSISTANT to the Professor of Physiology—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8.

SCIENTIFIC OFFICERS and EXPERIMENTAL OFFICERS in Ministry of Supply Establishments concerned with the whole field of scientific research for the Services, for Civil Aviation and for a variety of industrial purposes, in the fields of: Chemistry (Ref. F.355/48), Biochemistry, Physiology, Pharmacology (Ref. G.184/48), Aerodynamics (Ref. A.160/48), Aircraft Structural Theory (Ref. C.301/48), Gas Turbines (Ref. C.299/48), Physics (Ref. A.159/48), Radar (Ref. A.161/48), Aircraft Instrumentation (Ref. C.300/48), Metallurgy (Ref. F.356/48), Mathematical Applications (Ref. A.158/48)—Technical and Scientific Register (K), York House, Kingsway, London, W.C.2.

CHEMIST with research experience preferably, though not necessarily, in field of protein fibres—The Director, British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester.

SENIOR TECHNOLOGIST—The Secretary, British Rayon Research Association, Bridgewater House, 58 Whitworth Street, Manchester 1.

BIOCHEMIST (non-medical)—The Secretary-Superintendent, County Hospital, Lincoln.

ASSISTANT TECHNICIAN IN THE ZOOLOGY DEPARTMENT—The Registrar, University College, Southampton.

LECTURER IN LIVESTOCK HUSBANDRY—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

SENIOR LECTURER, and a LECTURER, IN PHYSICS, at the University of Otago, Dunedin—The High Commissioner for New Zealand, 415 Strand, London, W.C.2.

STATISTICIANS in the newly created Statistical Department of the Government of Nigeria—The Director of Recruitment, Colonial Service, 15 Victoria Street, London, S.W.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Physical Society. Report on Colour Terminology. By a Committee of the Colour Group. Pp. iv+56. (London: Physical Society, 1948.) 7*s.* net. [135

A Description of Ordnance Survey Small Scale Maps. Pp. v+21+19 plates. (Chessington: Ordnance Survey Office, 1947.) 1*s.* 6*d.* [135

A Description of Ordnance Survey Large Scale Maps. Pp. v+23+9 plates. (Chessington: Ordnance Survey Office, 1947.) 1*s.* 6*d.* [135

F.P.A. Journal: Quarterly. Vol. 1, No. 1, April. Pp. 28. (London: Fire Protection Association, 1948.) n.p. [185